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1901---1902.

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REPORT.

To His Excellency the Right Honourable BARON MILNER OF CAPETOWN AND ST. JAMES, *Knight Grand Cross of the Most Honourable Order of the Bath, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Administrator of the Transvaal, and His Majesty's High Commissioner for South Africa, etc., etc., etc.*

MY LORD,

By your Excellency's Commission of the 4th day of November, 1901, we were directed to enquire into the Water Supply of the Witwatersrand under the following terms of reference:—

(1) To examine the available sources of water supply;

(2) To prepare a scheme for the creation of an unfailing water supply for the Rand and the mines, taking into consideration future requirements; and

(3) To consider the constitution of a public body for carrying out and controlling the said scheme.

2. Two changes have occurred in the Commission as originally constituted, Mr. R. G. Fricker having resigned before our first meeting, and Major W. A. J. O'Meara having left the country on leave of absence during the progress of the enquiry. In place of these gentlemen, Your Excellency was pleased to appoint Mr. B. Kitzinger and Mr. W. St. John Carr respectively.

3. In obedience to Your Excellency's commands, we have considered the matters referred to us. We have held a public enquiry extending from the 4th November, 1901, to the 3rd February, 1902, at which numerous witnesses were examined, and we believe that we have obtained all the information possible at this stage under the powers conferred on us. We were of opinion that it would be proper that certain parties, whose interests might be affected by our report, should be legally represented before us; and accordingly the Town Council of Johannesburg, the Johannesburg Waterworks Estate and Exploration Company, and Mr. G. H. Goch, as owner of the "Wonderfontein Concession" from the late Government, were so represented throughout the enquiry, while the promoters of a Vaal River scheme were represented while their proposals were under examination. We desire to express to the legal gentlemen in question, and to the witnesses generally, our thanks for the assistance which they rendered to the Commission. Some of the witnesses came from considerable distances in order to give evidence, and it was not always easy, under the exigencies of military operations, to secure their attendance.

4. We would specially mention our indebtedness to Mr. W. Willcocks, C.M.G., the Managing Director of the Daira Sania Land and Irrigation Company in Egypt, whose evidence was full of interest; and to Mr. A. Karlson, Engineer to the Provisional Town Council of Pretoria. The latter gentleman furnished us with a series of memoranda on the different branches of our enquiry, as also on certain questions which lie outside the terms of reference to us, and these will be found among the appendices to this Report. Many of the points which he discusses are of great importance, and while some of his conclusions are based on theories which would require experimental verification, the special value of his work appears to us to lie in the fact that, wherever the nature of the case has admitted, he has given in full the data and calculations on which he bases his views. On the technical questions discussed by him we are not qualified to express a final opinion.

5. In addition to taking evidence, the minutes of which are annexed to our Report, the Commission personally inspected the Johannesburg Waterworks at Zuurbekom (where the Company gave them every facility for examining the works) and the springs at Wonderfontein and Steenkoppies.

REQUIREMENTS OF THE RAND.

6. The first consideration in preparing a scheme for an adequate water supply to the Rand is the requirements of the districts to be served, and these may be taken under three heads: (*a*) the requirements of the municipal area of Johannesburg; (*b*) those of the townships outside that area; in each case excluding (*c*) those of the mines. The first and second of these are dependent on two factors—the probable number of the population within a reasonable period, and the number of gallons to be provided per head. Much evidence has been given on these points, and widely differing views expressed, especially on the requirements per head.

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7. The late Government did not collect Vital Statistics, and there is consequently no accurate information available as to the number of the population of the Rand immediately before the war; but there is a general impression that the population of Johannesburg district was approximately 100,000 whites and 40,000 to 60,000 natives. The Town Council are of opinion that within the next five years the municipal population will increase to 200,000 whites and 80,000 natives, or, say, 300,000 in all; but in our opinion this view must be received with caution. It appears to be grounded on the assumptions that the operations of the mines will at least be doubled, and that the population will grow *pari passu* with mining development. The first assumption may be accepted as probable, but the second is purely conjectural, and only experience can decide whether, in the stage of development to which Johannesburg has now attained, an increase of mining activity carries with it a proportionate increase in the general population It is true that each extension of mining business requires additional workers for whom accommodation must and will be provided. But the population of a large and flourishing town like the Johannesburg of to-day must contain a considerable proportion of persons not directly connected with the mines, but attracted thither by its general possibilities; and as the land requisite for future expansion is largely in the hands of private persons, and is steadily rising in value, it would seem at least possible that the cost of acquiring and developing building sites will have a progressively increasing tendency to reduce the rate of increase in the population. However, though we look on the estimate of the Town Council as possibly open to criticism, we do not regard the matter as of cardinal importance, for, as we shall shew later on, we think the water scheme should be so framed as to give an adequate supply for present requirements, while providing for extension when experience has given data from which inferences of reasonable certainty can be drawn.

8. On the question of the requirements per head of population, opinions, as we have said, differed widely. A Medical Commission which sat in Johannesburg in 1896 recommended a supply of 40 gallons per head per diem, and Mr. Willcocks was of opinion that this was "far in excess of all requirements to-day," and would be ample, even with sewers, provided meters were used. Mr. Karlson, for a population of 100,000, including native servants, and with a sewage system, advises a daily supply of 11,200,000 gallons—*i.e.*, an average of 112 gallons per head The Town Council estimate that for the present normal population—estimated at 100,000 whites and 60,000 natives within the three-mile radius—from 40 to 60 gallons per head for whites and 40 gallons per head for natives, should be provided—*i.e.*, a total daily quantity of from 6,400,000 gallons as a minimum to 8,400,000 gallons as a maximum. They consider that within five years the white population will have increased (within a five to six mile radius) to 200,000 and the black to 80,000; that as the white population increases the demand per head will increase; and that the allowance per head for whites should then be raised to 70 gallons; so that in five years' time the total required will be about 19,000,000 gallons per diem. The view that the consumption of water per head increases with the increase of population is said to be borne out by the experience of other large and growing towns.

Q. 15.
Q. 56.
Q. 2214.
Q. 713, 934, 997, 998, 1004.
Q. 775.
Q. 719.
Q. 1114.
Q. 723.
Q. 935, 939, 994.

9. The lowest estimate is that of Mr. Thomas Stewart, Consulting Engineer to the Johannesburg Waterworks Company, who considers that 30 gallons per head would be sufficient with a sewage scheme, and that without such a scheme 20 to 25 gallons would be a very ample supply. For present requirements he thinks that 20 gallons per head should be provided for 100,000 whites, and six gallons per head for 40,000 natives, a total of 2,240,000 gallons per diem. For the increase in the population contemplated by the Town Council, and with a sewage scheme, he considers that a sufficient supply would be 30 gallons for 200,000 whites and 10 gallons for 80,000 natives, or a total of 6,800,000 gallons per day.

Q. 1464 to 1466.
Q. 1478.
Q. 1476.

10. Much evidence was offered as to the consumption in towns in various parts of the world. We do not attach great importance to the figures adduced, as we have no knowledge of the conditions in each instance, and we think that the case of Johannesburg must be decided on its own merits. No doubt, if water could be procured without cost and also removed without cost, it would be well to have an unlimited supply. But we have to bear in mind that Johannesburg is situated on a hill, 6,000 feet above the sea-level, that the supply of water, though abundant, is not unlimited, that it will probably have to be raised to an average height of about 1,000 feet before it is delivered to the consumer, and that the cost of machinery and labour is heavy. We therefore dismiss Mr. Karlson's estimate of 112 gallons per head as a counsel of perfection. It is true that he proposes to recover a portion of the water and to use it a second time after purification, but we are not prepared to recommend the suggestion. We equally dismiss the estimate of the Waterworks Company as being, in our judgment, quite inadequate for the health, to say nothing of the comfort, of the community. As regards the estimate of the Town Council, we are inclined to regard it as somewhat liberal, but as, under our proposals, the Council would be required to guarantee payment for the water which they desire to be supplied for the use of the town, we think that every effort should be made to comply with their demands, as these may be finally formulated by the Council, having regard to the period which must elapse before the delivery of water could be begun under our scheme. Hitherto the

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Waterworks Company have never supplied more than about 800,000 gallons per diem to the town; and even with the new machinery now being erected at Zuurbekom, they cannot safely count on being able to regularly provide more than 2,000,000 gallons for (as we understand) town and mines combined. Q. 1880.

11. The question of the requisite supply to the townships on the Rand is very difficult in the absence of statistics, but it is, fortunately, not of immediate importance. The Chamber of Mines, in their statement of requirements, have included the whole mining population of the Rand and the whole population of Germiston; so that for practical purposes we are only concerned with the non-mining population of Boksburg and Krugersdorp. We have applied to the Resident Magistrates of these places for such information as they can give as to the number of inhabitants, and we gather from their replies that the amount required in the immediate future for the non-mining population of these townships will form such a small proportion of the total to be provided that it need scarcely be taken into separate consideration. Appendices C. 1 and C. 2.

12. In dealing with the requirements of the mines, we are happily on firmer ground; for the Chamber of Mines are able to calculate with exactness the quantity of water lost in their operations, and the only uncertain factor is the extent of mining development in the future. It appears that, of the water used in crushing, about 400 gallons are lost per ton of ore crushed, that the duty per stamp is approximately 5 tons per diem, that 6,000 stamps were in operation before the war, and that it is estimated that 17,000 stamps will be at work in five years' time. On these figures the Chamber consider that by 1908 the mines will require 20,000,000 gallons per diem, exclusive of the water now available for their purposes, and that this amount will provide not only for mining operations, but allow for the domestic wants of the white and native population on the mines, and of the non-mining population within the mining area exclusive of Johannesburg, Boksburg, and Krugersdorp. By the time that the mines attain their fullest development, it is expected that the 20,000,000 gallons will have to be increased to 30,000,000. Q. 1458. Q. 1366.

13. The evidence before us does not enable us to say what quantity of water from outside sources will be required by the mines as soon as the 6,000 stamps now erected are at work, and we imagine that this will partly depend on the nature of the action that may be taken on our report; but if the figures adduced by the Town Council and Chamber of Mines are accepted, it follows that by 1908 a total supply of over 39,000,000 gallons per diem will be wanted for the whole Rand.

Available Sources.

14. This brings us to the second part of our enquiry—the sources from which such a supply can be derived, and two main sources at once present themselves, viz., river water and water from underground. We will deal with the latter first, as we have no hesitation in recommending that it should be resorted to in the first instance.

15. The Witwatersrand is surrounded, except at its eastern end, by a dolomite formation. This rock is permeable to water, absorbing a certain proportion of the rainfall, and contains numerous underground caverns and fissures in which the water so absorbed accumulates, and may even flow in definite subterranean channels. It is intersected in various places by impervious dykes, which arrest the percolation or flow as the case may be, and force the water to rise to the surface, where it is discharged in the form of springs. It is thus possible to obtain water in two ways—by leading it away as it issues from the springs, and by sinking shafts into the dolomite, into which the water will filter, and from which it can be raised by pumps. The yield of the shaft will of course be much greater if it should happen to strike a fissure or cavern. Q. 1495.

16. The quality of the water so obtained appears to be excellent. Mr. Schumacher speaks of it as "thoroughly suitable for drinking and mining purposes," and it appears that (except in cases where local conditions may cause pollution from surface water) it may be safely employed for domestic use without filtration. Q. 2660.

17. As to the total amount of water available from the dolomite, opinions will naturally differ in the absence of those scientific data which would have been accumulated in the past if the late Government had had any conception of its duties in this respect. Mr. Willcocks has calculated on the map the catchment basin of the Klip and Mooi Rivers (excluding the catchment area of Steenkoppies, where the map was unintelligible to him) to be 540 square miles, which—assuming the yearly absorption of rain water to be 3 inches—would give 3,500 million cubic feet as entering the dolomite annually. He reckons that the various springs discharge between them 2,000 million cubic feet, thus leaving 1,500 million cubic feet per annum as a reserve capable of being drawn from independent wells as it escapes from channels other than the springs. His conclusion is that the "dolomite water will suffice for everything;" and we may compare with this the view of Mr. Stewart that, taking into account both river and dolomite water, "there is abundant water within 50 miles for ten Johannesburgs." Letter of 12th Nov., 1901, 2nd days' evidence, pp. 10-11. Q. 1531-3.

18. The element of uncertainty in Mr. Willcocks' calculation is the quantity absorbed by the dolomite, having regard to the facts that the rainfall is confined to certain months of the year, and that it generally occurs in the form of violent rainstorms, so that the water rushes over the ground instead of lying and being absorbed

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when it falls. There is at least a theoretical danger that by making too great demands on the dolomite in any particular locality we might be, as it were, living on our capital—*i.e.*, taking from the accumulated stores within the rock more than the annual rainfall could replace—so that after the lapse of a certain time we might find that our water supply failed, and that the particular source of supply would not again be available until after a long period of recuperation. It has been suggested by Mr. Karlson that the absorptive powers of the dolomite might be increased by "absorption dams," to be constructed after careful study of the ground, which would hold up a portion of the rainfall and allow it to filter into the rock. Both these points require scientific investigation, which, indeed, we regard as an essential preliminary to a scheme of any magnitude.

Q. 2183, 2190.

19. We do not propose to discuss at any length the question of obtaining water from the rivers. A somewhat crudely developed scheme for obtaining up to 30,000,000 gallons per diem from the Vaal River, in the neighbourhood of Vereeniging, was offered for our consideration, but we have been unable to find in it anything which we could recommend. Mr. Goch regards the water for some distance above Vereeniging as liable to dangerous pollutions from the mines; Mr. Stewart considers that without filtration the Vaal water "is out of the question"; Mr. Willcocks says that the water from the Vaal is not so good as that from the dolomite: and Mr. Karlson states that artificially filtered surface water will never compare with a natural underground water supply.

Q. 613 *ff.*, 1122 *ff.*

Q. 295, 300.

Q. 1517.

Q. 26.

Q. 2176.

20. Even, therefore, if it should be found that after allowing for the cost of filtration, river water could be supplied somewhat more cheaply than the other, we would still recommend that in the first instance the supplies for the Rand should be obtained from the dolomite. We do not, however, suggest that under no circumstances should recourse be had to the rivers. On the contrary, we think that, when the mines have developed to an extent that makes necessary increased provision for their requirements, it might be well worth considering whether a second pipe-line should not be laid to carry unfiltered river water for purposes other than human consumption. This, which would relieve the pressure on the dolomite water, is a question for the future; but we may observe that Mr. Willcocks advises us not to lay one big pipe sufficient for all future demands, but to lay a second pipe if necessary, and he mentions that Cairo has a double system of pipes—carrying filtered and unfiltered water respectively.

Q. 127.

Q. 82.

21. We may now briefly notice the various projects which have come before us for obtaining water from the dolomite.

22. The Johannesburg Waterworks began with local sources—Doornfontein and Weltevreden—from which it is stated that they got from 600,000 to 900,000 gallons, according to the season; but the quality and quantity of this water gave rise, according to the Commission of 1895, to "everlasting complaints by the public." About 1896 they acquired the farms Steenkoppies and Wolvekrans, and, later on, a portion, stated to be about ten morgen, of the farm Zuurbekom; but the two former were not made use of, as the Company found that Zuurbekom would supply at least 1,000,000 gallons per diem, which was the greatest amount that the Company then considered they would be justified in attempting to secure. Weltevreden seems to have been regarded as useless for any considerable supply.

Q. 1482.

Appendix B.

Q. 1488.

Q. 1490, 2149.

Q. 1491.

Q. 1807-9.

Q. 1488.

Q. 1506.

Q. 1825.

Q. 1509.

23. Steenkoppies is a spring 14½ miles west of Krugersdorp, and 34½ miles from the Company's high-service reservoir and 1,170 feet below it. Mr. Stewart estimates that it has a flow of 15,000,000 gallons per diem; he regards it as the outlet of an underground river, and considers that 10,000,000 gallons could be taken from it, without injury to riparian owners, by making a compensation reservoir. Mr. Willcocks in his evidence put the flow at from 9,000,000 to 10,000,000 gallons.

Q. 21.

24 Zuurbekom (660 feet below the reservoir and 18½ miles from it) is not a spring. The water is obtained by sinking shafts, in which it rises to a certain distance from the surface. The Company claims to have drawn up to 1,000,000 gallons per day without affecting the level of the water. This is the full capacity of their lifting pump, but two other pumps of the same power are about to be erected, and the Company consider that in six months' time they will be able to pump 2,000,000 gallons per diem, keeping one pump in reserve.

Q. 1496.

Q. 1499.

Q. 1500.

25. Mr. Stewart considers that provision might be made for taking up to 5,000,000 gallons, or even more, from Zuurbekom, but without experience it is impossible to say positively whether the supply would permanently respond to a demand for five, or even two, million gallons in the same way that it does to a demand of one million. No flow can be detected in the water, and therefore the shafts must be fed by percolation. Under the present law, any owner outside the farm might lawfully intercept such water, and thus materially diminish the supply. Moreover, Mr. Karlson has raised a theoretical point of great importance. On a consideration of the levels in the neighbourhood, he is of opinion that Zuurbekom, instead of being in a depression, is on the dividing line of the underground water level between the valleys of the Mooi and Klip Rivers. These are matters which must be cleared up before it can be decided whether Zuurbekom could be counted on as a permanent source of supply on any considerable scale for the Rand.

Q. 2209-2210.

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26. According to Mr. Goch's engineers, the Wonderfontein source has a total discharge of 30 to 30½ million gallons, of which 9½ come from the "loop," and the remainder from the springs. Mr. Willcocks, on a necessarily brief examination, puts the amount much lower—under 22 million gallons. After flowing a short distance the water disappears underground. Local residents are firmly persuaded that it reappears later on and feeds the head-waters of the Mooi River; but Mr. Goch denies this, and certain rather crude experiments, made some years ago with a view of testing the theory, have given negative results. Q. 158, 161. Statement 2nd day, p. 10. Q. 166.

27. Mr. Karlson has no doubt that such a connexion exists, the only question, to his mind, being whether it is by percolation or by a defined channel, though he seems to favour the latter theory. By scientific experiments, properly conducted, it would be easy to settle the question beyond all doubt, and we consider it essential that this should be done if the Wonderfontein spring is to be utilised as one of the sources of our water supply. Not only is the land along the Mooi River suitable for agricultural development, but the town of Potchefstroom derives its water supply from the river, and any undue interference with its flow is to be avoided. Mr. Karlson has suggested that by constructing absorption dams the Wonderfontein supply might be increased to the extent of at least 6,000,000 gallons daily. Q. 2202. Q. 2260. Q. 2199.

28. Mr. Goch's concession gave him the right to take one-quarter of the water from Wonderfontein, and he contends that no one can deal with the remainder for the purpose of supplying water to Johannesburg. Though we are unable to speak authoritatively on the point, we are inclined to think that there is nothing in the concession, even if recognised by His Majesty's Government, which would prevent the Transvaal Government from making use of the remaining three-fourths for the purpose of a public water scheme; and in this connexion we would refer to the opinion with which the Legal Adviser has favoured us, and which will be found appended to our report. Q. 151-3. Appendix A.

29. Mr. Karlson has submitted to us an interesting project for supplying water by means of a series of shafts sunk in the Klip River Valley and connected by underground galleries. He has worked out in detail an estimate, according to which, under this scheme, 22,000,000 gallons could be delivered daily at a cost of from 7d. to 8d. per 1000 gallons (excluding, apparently, the cost of acquiring sites). We are not in a position to offer any opinion on the value of the figures supplied by Mr. Karlson. These will doubtless be examined hereafter by experts, if necessary, but we shall be surprised to find that the cost of supplying water under such a scheme would work out at anything like what Mr. Karlson suggests. Q. 2180 *f.f.* Q. 2195.

30. Some years ago certain of the mining companies, in anticipation of their future requirements, began to study the question of increasing their water supplies. The Vierfontein Syndicate was founded in 1893 for this purpose, and by the time that war broke out they had expended over £340,000 in making experiments and purchasing water sites and machinery. They considered that towards the end of 1897 they had their hand on a daily supply of 3,000,000 gallons from the dolomite formation, and they looked forward to being able ultimately to supply themselves with between nine and ten millions daily. Q. 2660.

31. The Syndicate directly represented four of the most important groups, who, between them, dealt with between a half and two-thirds of the total tonnage of ore crushed on the Rand; but they made offers to all other mines within a certain area to participate in the scheme, and these offers were, in nearly every case, accepted.

32. Mr. Schumacher, to whom we are indebted for the above information, observes:—"If the Government should desire to supply the mines with water, the latter will be "anxious to give assistance; but, naturally, having spent so much money on the "central and eastern districts, they will be anxious to exploit these rights to the "utmost, and they would probably, therefore, be willing to take from the Government "only the deficiency of water that may be experienced, which will not be great until "the expansion of the gold-mining industry begins to take place." We understand this to mean that the Syndicate would be willing to treat for the acquisition of their assets as part of a general scheme. We will recur to this question later on, but there is one point in connection with it which should not be lost sight of. If water is to be supplied for all purposes from one system, it must be of such a quality that it can safely be used for household purposes. Some of the Syndicate's property is in the immediate neighbourhood of a proposed depositing site for the town, and if the site be so used it would be necessary to carefully investigate the possibility of pollution from this cause. Indeed, a careful chemical and bacteriological examination should be made in every case where it may be proposed to acquire a water source, and the water should be tested at frequent intervals over a certain period of time.

33. For convenience of reference, we have taken over the translation of the Report of the Water Commission of 1895, which was made by the Concessions Commission, and we append it to our report. It will be seen that they had twelve schemes before them, and, on various grounds, rejected all but the Wonderfontein project. We cannot form an estimate as to the value of the report, as we know nothing of the nature of the enquiry on which it was based. In any case, circumstances have greatly changed since 1895, and none of the schemes discussed therein would supply more than a fraction of the demand which we are now called upon to meet. Appendix B.

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RECOMMENDATIONS.

34. It will not be expected that we should be able to formulate a scheme in all its details for the supply of water to the Rand. Before embarking on an undertaking of this magnitude, in which a large amount of capital must be sunk, it will be necessary to have the best engineering assistance, and to make a careful study of various problems, to some of which we have already alluded, connected with the water supply. We have not the means for this at our disposal, nor are we the proper body to undertake the work; and we therefore consider that the enquiry has reached a point where it should be transferred to other bands.

35. But while we are not prepared to draw up a complete scheme, we have arrived at certain conclusions as to the lines on which it should be framed; and these we now proceed to submit.

36. In our opinion:

(1) A Board should be constituted by legislation, to be styled "The Rand Water Board." It should be composed, in the first instance, of a chairman appointed by the Governor, three members elected by the Town Council of Johannesburg, three elected by the Chamber of Mines, and one elected by the townships on the Rand outside Johannesburg. The last-named member, and one each of the representatives of the Town Council and Chamber of Mines should retire at the end of every year, but be capable of re-election. The Board should decide by a majority of votes, and the chairman should have an original vote, as well as a casting vote in cases of equal voting. The members of the Board should receive a reasonable remuneration.

(2) The Board should be charged with the duty of supplying water to the Rand from Randfontein to Springs.

(3) The Board should be empowered, with the approval of the Government

(*a*) To acquire, either by voluntary agreement or by compulsory expropriation under arbitration, such water sources, sites for water boring, protective areas, dams or reservoirs, and such existing undertakings for the supply of water, as it may deem fit; and to obtain way leaves for its pipe-lines, subject to no other compensation than for actual damages;

(*b*) To raise loans for carrying out any of the objects for which the Board is constituted.

The interest and principal of these loans should be secured on the general assets and revenue of the Board, but should also be guaranteed by the Colonial Government. The loans should have a moderate term of currency and their repayment should, in the case of debentures issued, be provided for by a sinking fund.

(4) The Board, as soon as constituted, should provide itself with such technical staff as it may require for its preliminary investigations. Pending the raising of debentures, it should be put in funds by advances from the Colonial Treasury, repayable with interest.

(5) The distribution of water within the Municipality of Johannesburg should be in the hands of the Town Council, which would be in the position of a wholesale customer of the Board, drawing the whole town supplies by metre from the Board's trunk line and paying therefor at a rate to be agreed upon. It would probably be possible and desirable to make similar arrangements with mines or groups of mines, and (sooner or later) with townships. The position of the Board would then be that of a wholesale trader, supplying a few large customers and having nothing to do with the water after it had once left the trunk line. But it is probable that at first some of the townships may not be so organised that they would be capable of undertaking their own distribution; in such cases the interests of the private consumer ought not to suffer, and the Board should have power, if they see fit, to undertake distribution.

(6) The Board should fix annually a uniform (wholesale) rate per 1,000 gallons, irrespective of the point on the trunk line from which the supply is drawn. This rate should be calculated to cover working costs, interest and sinking fund on debentures, depreciation of plant, and yearly maintenance, any surplus at the end of the year being divided among the customers in proportion to their consumption. If the Board should undertake distribution, as contemplated in the last paragraph, the capital account for such works should be kept separate; and the retail charge to the consumer would then be the wholesale rate, plus a charge to cover working costs, interest and redemption on this account and depreciation and maintenance of the subordinate system.

(7) Before constructing its works the Board should have a guarantee from each wholesale customer that it will receive and pay for a minimum amount each year, for a period to be fixed, should the Board be able to supply it. This provision we regard as essential. If the Board were to undertake

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certain works on the faith of representations made to it, and it were then found that one of its customers had largely over-estimated its requirements, so that the supply exceeded the demand, it is only fair that any loss should fall on that customer and not (indirectly) on the others. Of course the over-estimate in one direction might be balanced by an under-estimate in another, and in that case there would be no need to call on anyone for excess payments under his guarantee—the Board not being conducted for profit, but for the general benefit of the community.

(8) In the event of a scarcity of water the Board should be bound to apportion the deficiency among the consumers in proportion to their guaranteed requirements.

(9) The property of the Board should not be subject to municipal taxation within the area served by it.

37. Such, in outline, is the scheme we propose. It will be seen that there is no place in it for any private company or interest. The terms of reference to us seem to exclude any such idea, and, if this were not so, we should hold that there are at least two considerations which put it out of the question that any but a purely public body should be in a position to control the water supply of the Rand.

38. The first consideration is economy. If an abundant water supply is necessary to the progress of the mines, and therefore to the prosperity of the country, it is even more necessary to the health of the community grouped round the mines, and there can be no abundance to the average consumer without cheapness. There will never be any fear of water being over-abundant or too cheap on the Rand; we must do our utmost to supply as much as possible, and every saving in the cost will tell its tale in the health returns. There is, therefore, no room for promoters' profits or companies' dividends.

39. We may remark in passing that the mere ventilation of the subject by means of our enquiry has produced some significant results. The Johannesburg Waterworks Company have offered to "consider" reductions in their present charge of 1s. per 100 gallons, when the town's demand reaches 2,000,000 and 4,000,000 gallons respectively, or to supply 10,000,000 to the towns in bulk (*i.e.*, being relieved of the cost of distribution) at "under 2s. 6d. per 1,000 gallons." At a previous sitting Mr. Goch had made an offer to supply water to the consumer at 2s. 6d. per 1,000, provided the town took 5,000,000 gallons per diem, and not less than 10,000,000 were taken altogether. In each case Government assistance was a condition of the offer—the company requiring to be protected from claims by riparian owners, and Mr. Goch asking for a Government guarantee for £750,000 debentures.

Q. 354-5 and 435-6.

Statement of Waterworks Company, p. 117.

40. These offers are instructive—especially as the memorandum embodying the offer of the Johannesburg Waterworks Company appears to contemplate increased dividends for its shareholders—but we believe that the Board will be able to do better than this for its customers. If this is to be the case, the Board must proceed on strictly business lines, and must abstain from acquiring properties not well adapted for its purposes or whose price is excessive.

41. In this connection it is impossible to avoid reference to the position of the Waterworks Company, the Wonderfontein Concession, and the Vierfontein Syndicate. The first works under a concession from the late Government which—as is also the case with Mr. Goch's concession—has been reported upon by a British Commission. The decision of His Majesty's Government on these concessions has not yet been announced, but from our point of view we regard the question of their recognition or non-recognition as of little importance. No exclusive rights are anywhere given by either of the concessions. If a private company had carried through a rival scheme, the Waterworks would have had to accept the situation, however disastrous it might have proved to them; and the looking after one's own interests, which is proper in a company, is no less proper in the case of trustees for a quarter of a million people. To this we must add that according to the evidence adduced before the Concessions Commission, which accords with the experience of members of our body, there is nothing in the history of the past relations between the Waterworks Company and the town which would predispose the inhabitants, on sentimental grounds, to deal with the Company on other than business principles. Similarly, we do not think that the Board could entertain any claim to compensation for prospective profits under the Wonderfontein scheme.

42. The same principles are applicable, at least in part, to the Vierfontein Syndicate's property. There is, however, this difference that the scheme was not started for direct profit, but was an attempt on the part of the principal mining companies to provide for the necessary requirements of the industry in the future. If the Board and the Syndicate should not be able to come to an agreement, the mines concerned would probably not be willing to sacrifice the outlay already incurred, and would supply themselves with water up to the limit possible under their scheme. Even so, the Board would have a work of sufficient magnitude before it. If, on the other hand, a satisfactory agreement could be arrived at, there is no doubt that a water supply under one management should be more advantageous to everyone concerned.

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43. The second reason for excluding private interests from the control of the water supply is to be found in the extent of the powers that must be conferred on the Board. This applies not only to the proposed rights of compulsory purchase and interference with private property, which could not properly be entrusted to any but a public body, but also to the Board's position in regard to certain questions which might arise between the partners to the scheme. Without going into these, we may say that we regard it as essential that the various interests affected should be able to feel that the position of the Board is not complicated by the representation of private interests upon it, and that its decisions will be impartially arrived at.

44. Our scheme may be criticised on the ground that to place distribution in the hands of several different bodies is not an economical arrangement, and will increase the cost. It is possible that the objection is sound, so far as it goes; but be this as
Q. 724-728. it may, the Town Council have expressed the view that the distribution of water within the Municipal area should be a Municipal concern, and even if we disagreed with them we consider that their position would have to be accepted. We think, however, that they are right, and we feel confident that this arrangement will greatly promote the satisfactory working of the Board.

45. Evidence has been given before us as to whether the water supply should be taken from one source or from several. It is doubtless true that one source—if an adequate one could be found—could be equipped and maintained at smaller cost than several of the same aggregate capacity. But against this there are three considerations to be taken into account. In the first place, if several sources are taken, the effect of accident or damage to any one of them is minimised. In the second place, we are not likely to get, within a reasonable period, absolutely convincing data as to the permanence of any one supply under the demands that may be made upon it. Lastly, while we regard the provision of an adequate water supply to the Rand as a paramount necessity, we consider that this should be so arranged as to cause the least possible inconvenience to agriculture. We are somewhat sceptical as to the riparian rights of which we have heard a good deal; and we think that in many cases they might, under the conditions that have existed up to now, be used as little more than a kind of blackmail on the undertaking under cover of the existing law. But we believe that there is a prosperous future for agriculture in the vicinity of the Rand, and we consider that this should not be impaired by unduly depriving any one locality of its stores of water.

Q. 2212. 46. It has been suggested that a possible source of supply might be found to the north-east of the Rand. Before any proposal of this kind is acted on, its effect on the present water supply of Pretoria should be considered.

Q. 39, 72-3, 79-81. 47. We would invite attention to the suggestive remarks of Mr. Willcocks as to legislation on water rights. We have been favoured with an opinion by the Legal
Appendix A. Adviser, which is appended to this report, on certain aspects of the present law as affecting our enquiry; and we gather from it that there is a danger, if the law remains as it is, that our proposed Board might have to make extensive and costly purchases of land to serve as protective areas not only against pollution but also against the interception of percolating water by other parties.

48. In conclusion we desire to record our conviction that while the question of water supply is pressing, the possible result of mistakes are so serious that neither time nor money should be spared in endeavouring to avoid them. The inhabitants of Johannesburg have endured so much inconvenience in the past that we feel confident they will willingly put up with the present conditions somewhat longer, rather than, by precipitate action, endanger the success of a scheme from which they may expect such considerable results.

49. In placing this Report in Your Excellency's hands, we wish to express our recognition of the hard work which has devolved on our secretary, Mr. Gerard Craig Sellar, and our cordial acknowledgment of the assistance which he has been good enough to render us throughout the enquiry.

We have the honour to be,

My Lord,

Your Lordship's most obedient humble servants,

G. V. FIDDES (CHAIRMAN).
A. BRAKHAN.
W. ST. JOHN CARR.
B. KITZINGER.
W. McCALLUM.
JOHN W. QUINN.
G. ROULIOT.

26th February, 1902,

GERARD CRAIG SELLAR,
Secretary.

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Minutes of Proceedings.

MINUTES OF THE PROCEEDINGS

OF THE

Witwatersrand Water Supply Commission.

FIRST SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

Monday, 4th November, 1901.

Present:— G. V. FIDDES, Esq., C.B., (Chairman).
A. BRAKHAN, Esq.
B. KITZINGER, Esq.
W. MCCALLUM, Esq.
MAJOR W. A. J. O'MEARA, C.M.G., R.E.
J. W. QUINN, Esq.
G. ROULIOT, Esq.

G. CRAIG SELLAR, Esq., Secretary.

The following witness was examined:—

Mr. W. WILLCOCKS, C.M.G.,
Managing Director Daira Sania Land and Irrigation Company in Egypt.

SECOND SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

Monday, 25th November, 1901.

Present:— G. V. FIDDES, Esq., C.B., (Chairman).
A. BRAKHAN, Esq.
B. KITZINGER, Esq.
W. MCCALLUM, Esq.
W. ST. JOHN CARR, Esq.
J. W. QUINN, Esq.
G. ROULIOT, Esq.

G. CRAIG SELLAR, Esq., Secretary.

Two letters received from Mr. W. Willcocks, C.M.G., were read by the Secretary:—

(1) With regard to the Wonderfontein Source.
(2) With regard to the Catchment area of the Klip and Mooi Rivers.

The following witnesses were examined:—

Mr. GEORGE HENRY GOCH,
Mr. SAMUEL SYKES,
On behalf of the Wonderfontein Concession.

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Minutes of Proceedings.

THIRD SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

Monday, 16th December, 1901.

Present:— G. V. FIDDES, Esq. C.B. (Chairman).
A. BRAKHAN, Esq.
B. KITZINGER, Esq.
W. MCCALLUM, Esq.
W. ST. JOHN CARR, Esq.
J. W. QUINN, Esq.
G. ROULIOT, Esq.
G. CRAIG SELLAR, Esq., Secretary.

The following witnesses were examined:—

Mr. G. H. GOCH (concluded),
On behalf of the Wonderfontein Concession.

Mr. RICHARD LEWIS COUSENS,
Mr. THOMAS BENNETT,
On behalf of the Vaal River Scheme.

Mr. H. F. E. PISTORIUS,
Dr. W. T. F. DAVIES,
On behalf of the Johannesburg Town Council.

FOURTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

Monday, 30th December, 1901.

Present:— G. V. FIDDES, Esq., C.B. (Chairman).
A. BRAKHAN, Esq.
B. KITZINGER, Esq.
W. MCCALLUM, Esq.
W. ST. JOHN CARR, Esq.
J. W. QUINN, Esq.
G. ROULIOT, Esq.
G. CRAIG SELLAR, Esq., Secretary.

The following witnesses were examined:—

Mr. GEORGE SAMUEL BURT ANDREWS,
On behalf of the Johannesburg Town Council.

Mr. HENRY EDWARD HALSE,
Mr. RICHARD LEWIS COUSENS (concluded),
On behalf of the Vaal River Scheme.

Mr. A. R. GOLDRING,
Mr. G. B. POORE,
On behalf of the Transvaal Chamber of Mines.

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Minutes of Proceedings.

FIFTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

Monday, 13th January, 1902.

Present:— W. ST. JOHN CARR, Esq. (Acting Chairman).
A. BRAKHAN, Esq.
B. KITZINGER, Esq.
W. MCCALLUM, Esq.
J. W. QUINN, Esq.
G. ROULIOT, Esq.
G. CRAIG SELLAR, Esq., Secretary.

The following witnesses were examined:—

Mr. H. H. WEBB,
On behalf of the Transvaal Chamber of Mines.

Mr. THOMAS STEWART,
Mr. THOMAS RAYNES,
Mr. MONIER WILLIAMS,
Mr. JAMES PAUL O'REILLY,
On behalf of the Johannesburg Waterworks Company, Limited.

SIXTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

Monday, 20th January, 1902.

Present:— G. V. FIDDES, Esq., C.B. (Chairman).
A. BRAKHAN, Esq.
B. KITZINGER, Esq.
W. ST. JOHN CARR, Esq.
J. W. QUINN, Esq.
G. ROULIOT, Esq.
G. CRAIG SELLAR, Esq., Secretary.

The following witnesses were examined:—

Mr. H. H. WEBB (concluded),
On behalf of the Transvaal Chamber of Mines.

Mr. THOMAS STEWART (concluded),
Mr. THOMAS RAYNES (concluded),
Mr. JAMES PAUL O'REILLY (concluded),
On behalf of the Johannesburg Waterworks Company, Limited.

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Minutes of Proceedings.

SEVENTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

Monday, 27th January, 1902.

Present :— W. ST. JOHN CARR, Esq. (Acting Chairman).
A. BRAKHAN, Esq.
B. KITZINGER, Esq.
W. MCCALLUM, Esq.
J. W. QUINN, Esq.
G. ROULIOT, Esq.

G. CRAIG SELLAR, Esq., Secretary.

The following witness was examined:—

Mr. AUGUST KARLSON,
City Engineer, Pretoria.

EIGHTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

Monday, 3rd February, 1902.

Present :— W. ST. JOHN CARR, Esq. (Acting Chairman).
A. BRAKHAN, Esq.
B. KITZINGER, Esq.
W. MCCALLUM, Esq.
J. W. QUINN, Esq.

G. CRAIG SELLAR, Esq., Secretary.

The following witnesses were examined:—

Mr. AUGUST KARLSON (concluded),
City Engineer, Pretoria.

Mr. HENRY JAMES RAUBENHEIMER,
On behalf of Riparian Owners of the farm Uitspanning.

Mr. R. N. SCHUMACHER,
On behalf of the Vierfontein Syndicate, Limited.

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WITWATERSRAND WATER SUPPLY COMMISSION.

MINUTES OF EVIDENCE.

FIRST SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

MONDAY, 4TH NOVEMBER, 1901.

Present:

G. V. FIDDES, Esq., C.B., Secretary to the Transvaal Administration (Chairman).

A. BRAKHAN, Esq.,
B. KITZINGER, Esq.,
W. McCALLUM, Esq.,
Major A. W. J. O'MEARA, C.M.G., R.E.,
J. W. QUINN, Esq.,
G. ROULIOT, Esq.,

G. CRAIG SELLAR, Secretary.

(*The Chairman* opened the proceedings by saying):—This is a Joint Commission of the Johannesburg Town Council and the Chamber of Mines, with myself as Chairman, appointed by His Excellency the Administrator, to consider the question of the water supply for the Witwatersrand. By the terms of reference to the Commission our enquiry will naturally fall into three parts:—First, to examine into the available sources of water supply for the Witwatersrand; secondly, to prepare a scheme for the creation of an unfailing water supply for the population of the Rand and for the Mines, taking into consideration future requirements; and, thirdly, to consider the constitution of a public body for carrying out and controlling the said scheme. The Commission has been gazetted, and I may say since that took place one of the members of the Commission, Mr. Fricker, has been compelled to resign, and His Excellency the Administrator has approved of the appointment of Mr. Kitzinger in his place. It is proposed that the sittings should be held in this room, which has been kindly placed at our disposal by the Johannesburg Town Council. Due notice of the sittings will appear in the *Gazette*, but our present intention is that, after disposing of the evidence of the first witness (Mr. W. Willcocks), we should sit once a week on Mondays. Notice has been given in the *Gazette* that interested parties should apply to the Secretary to the Commission, at the Office of the High Commissioner, if they desire to give evidence, or if, for special reasons, they desire to be represented before the Commission. The Commission are of opinion that in certain special cases the right of representation should be given. The applications before the Commission for such representation which the Commission has decided to agree to, are from the Town Council, the Johannesburg Waterworks, Estate, and Exploration Company, and from Mr. Goch, as interested in the Wonderfontein Concession, which was the subject of an enquiry before the Concessions Commission recently. The procedure will be that, when the Chairman has concluded his examination of a witness, the gentlemen representing these three bodies will be allowed to put questions through the Chair.

1. (*The Chairman.*) Does anyone appear on behalf of the Johannesburg Town Council?

(*Mr. Lance*, of the firm of Messrs. Lance & Hoyle, Legal Advisers to the Johannesburg Town Council). I appear on behalf of the Johannesburg Town Council.

2. (*The Chairman.*) Does anyone appear on behalf of the Johannesburg Waterworks, Estate, and Exploration Company?

(*Mr. Thomson*, of the firm of Messrs. Solomon & Thomson). I appear on behalf of the Johannesburg Waterworks, Estate, and Exploration Company.

3. (*The Chairman.*) Does anyone represent Mr. Goch?

(*Mr. H. C. Hull*). I represent Mr. Goch at this enquiry.

W. Willcocks, C.M.G., called and examined:

4. (*The Chairman.*) Mr. Willcocks, you have had very considerable experience in connection with water and irrigation schemes, and perhaps you would kindly indicate to the Commission the nature of your experience in these matters?—From 1872 to 1883 I was in the Irrigation Department in India; from 1883 to 1895 I was Inspector of Irrigation and Director-General of Reservoirs in Egypt; from 1895 to 1897 I was Director-General of the Land Tax Adjustment in Egypt; from 1897 to 1899 I was Managing Director of the Cairo Waterworks Company, and prepared a drainage scheme for Cairo. From 1899 until to-day I have been Managing Director of the Daira Sania Land and Irrigation Company in Egypt.

W. Willcocks C.M.G.

November 4, 1901.

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W. Willcocks C.M.G.

November 4, 1901.

5. And we understand that, at the instance of His Excellency the High Commissioner you have come over to South Africa to investigate the water problems here?—Yes, irrigation problems.

6. Irrigation problems chiefly?—Yes.

7. You have been in the Transvaal for some little time?—Since the 7th of last month.

8. And you propose to leave us very shortly?—Yes, almost immediately.

9. Although you are primarily concerned with irrigation, you have examined the country and the neighbourhood of the Rand from the point of view of water supply?—Yes. In the neighbourhood of the Rand I have not considered it necessary to think of water storage for irrigation, and I may say that all my thoughts have been how to get a water supply for the Rand.

10. Therefore, it strikes you that the primary thing to consider now is an adequate supply of water for all the requirements of the mines and the inhabitants on the Reef?—Yes, as the prosperity of South Africa entirely depends on this place.

11. I suppose you have a general knowledge of the previous steps that have been taken in regard to this question of water supply?—Well, I have read a good deal of the literature here dealing with the matter.

12. Among others, the report of the Committee of 1895?—Yes, I have read the general results of that enquiry.

13. And you doubtless have arrived at certain conclusions as to the steps which should be taken for supplying the future requirements of the Rand—by the Rand is meant the reef running from Krugersdorp to Boksburg—the mines and the town of Johannesburg, and a possible margin for a drainage scheme?—I do not approve of a water drainage scheme for Johannesburg.

14. Before we go into the actual result of your investigation, might I ask upon what basis you have calculated the minimum water consumption?—I saw that a Medical Commission, which sat in Johannesburg in 1896, suggested that a minimum of forty gallons per head per day should be allowed for the population of Johannesburg.

15. For the population per head?—Per head, yes. As that Commission was composed of medical experts I have accepted their statement. This Commission states in their report, which is dated the 5th of February, 1896, that they recommend for the town of Johannesburg a supply of forty gallons per day per head, which represent about six and a half cubic feet per head per day.

16. What population do you assume?—I assume about one hundred thousand persons, but people say that it is going to be two hundred thousand in the future.

17. I take it, of course, that your enquiries have been based on the maximum amount of water which could possibly be required per head?—That is so.

18. The other factor is the number of people who want the water, and I suppose you have assumed a certain figure in your own mind?—Yes. Forty gallons per head per day. The Johannesburg Waterworks Company supply at present one million gallons per day to 100,000 people; so the town to-day is contented with a quarter of the above provision.

19. And in regard to the future requirements of the mines?—The mines are entirely different.

20. Have you formed any conclusions from your enquiries?—As far as I can understand I can say that the water can be found. Allowing forty gallons per day, if Johannesburg has a population of one hundred thousand people, we need seven and a half cubic feet per second. If the population is two hundred thousand people we need fifteen cubic feet per second. These are the two maximum quantities required for the population. From my enquiries I have ascertained that it takes forty cubic feet of water to wash out a pound of gold, and that this water is absolutely wasted. And as Johannesburg produces about twenty millions sterling per annum, it works out to twenty-five cubic feet per second. Of this quantity I understand that the whole is in a way already provided by reservoirs, springs, etc., but that half this should only be considered as assured in years of drought. That will leave twelve and a half cubic feet to be provided for from outside, and if the gold industry is going to be doubled, that will add another twenty-five cubic feet per second, as reservoirs cannot be further relied on. This works out to a final total of 15 added to 12½ added to 25 or 53 cubic feet per second.

21. Then, postulating these requirements, perhaps you would be so good as to tell the Commission what you have been able to do in the way of examining the sources of supply?—I have tried to see some of the sources of supply. I have seen Steenkopjes for instance. I see in the Commission that I mentioned before that Steenkopjes is put down as delivering from twenty-two to twenty-five cubic feet per second. Now, when I saw the spring I should say that it was delivering from nine to ten cubic feet per second. Judging from my aneroid, Steenkopjes at the Rustenburg road, is about 4,800 feet above the sea level. And the Johannesburg reservoir is, according to Mr. Melville of the Gold Fields Company, 5,970 feet above the sea level. That means a lift of about 1,170 feet. Steenkopjes is about 17 miles from Krugersdorp. Then there is the Zuurbekom Water Well Works; they strike water at about forty feet below the surface, but when they pump up to their one million gallons per day, it stays permanently at eighty feet below the surface, and the Company considers it inexhaustible. The level of the water works out to 5,110 feet, so that they lift 660 feet. The company who owns those works are trebling their plant, and are also building large sheds and everything else.

22. Did you tell us what you estimated the Zuurbekom supply at?—Zuurbekom is not a spring. As I understand, they have lifted up to one million three hundred thousand gallons a day, and that has not affected the surface water more than when they have lifted a million gallons. So it seems to have a good supply, and as far as I can make out, the source of the Klip River and Gemsbokfontein, the source of the Mooi River, and

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W. Willcocks C.M.G.

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the permanent level of the water at Zuurbekom when they work are at one and the same level. The Klip River, where I took the discharge at Jackson's Ford, was about ten cubic feet per second, about the same at Steenkopjes. I must say that these discharges are rather difficult to take as I found in Greece when I was doing similar work. The springs come out and go into weeds, rushes, and general marsh land, and it is necessary to get a good channel for taking the real discharge. If anything had to be done definitely, it would be necessary to build a masonry or plank weir so that one could actually measure without any doubt. I see that my discharges are generally under those previously reported. I tried to get to Wonderfontein to inspect that place, but, unfortunately, I was taken for a Boer, and had to retire quickly, and consequently did not see it.

23. Then your knowledge of the capabilities of the Wonderfontein scheme is derived from what you have read?—The discharge is really wonderful from what I have read, but I may say that I propose to see it personally to-morrow or the next day, so as to examine it for myself.

24. Possibly, if you do succeed in seeing it, you would be so good as to give us a report on the subject, which could be printed after your evidence?—Yes, I shall certainly send you a report.

25. In those sources that you have mentioned, do you consider that any one would give the total supply of water that is required?—I should like to take it from all the sources, because all these springs have cultivation depending on them, and though cultivation is a trifle as compared to the prosperity of the Rand Mines, it will be a great pity to deprive one set of people only of their irrigation supplies. As the quantity of water that will be wanted will be very large, it would be a fairer method to my mind to get it from all the sources. And, besides, it would, I think, be unwise in a place like the Transvaal, where things will not settle down in a day, to depend on one site alone. You must not leave out the consideration of the possibility of someone damaging or destroying the works. If such were to happen, it would result in there being no water for two or three weeks or even more, which would certainly be disastrous.

26. You have not alluded to the possibility of taking water from the Vaal River?—I do not consider that the water of the Vaal is as good as this filtered water from the dolomite. The chemical analysis describes this water as first-class water, and the water of the Vaal River, of course, would only be surface water, and consequently muddy. You would have to filter it as far as drinking water goes, and you would, therefore, have to keep it separate from the water for the mines, and a separate station would have to be made so as to provide Johannesburg with filtered water. Besides that, as far as I can see, the water of the Vaal River runs very low for some months every year, and you would, therefore, have to make a reservoir to store it. The Vaal River at Vereeniging is 4,750 feet above sea level, and the water would have to be raised 1,220 feet. I have seen schemes for utilising the water power of a very fine series of rapids at Engelbright's Ford, some 15 to 20 miles up stream at Vereeniging, which I examined, but you could only use the turbines when you had plenty of water to spare, and during the three months when you were hard up for water, you could not afford to waste any of it on your turbine, consequently you would have to provide a steam pumping plant at the site, so as to be ready in case of your water failing. Now, considering that there are very good coal mines quite close to Vereeniging, where you can almost get your coal at the pit's mouth, everything points to the turbine project being valueless.

27. Do I understand from what you say that, if the Vaal River scheme was under consideration, it would be absolutely necesary to build extensive dam works?—Not very extensive, because the Vaal is a good river for storing water. I would say, so far as I can make out, that a fifty feet dam, provided with proper gates, would not be very expensive. You would have your reservoir, and your turbine, and steam pumping plant as well.

28. Hence, duplicating the pumping power?—Yes.

29. Can you give me any idea of the duty done by a given quantity of water working a turbine?—Not straight off, but I could after making a calculation.

30. I may take it that it takes a large flow of water to raise a much less amount?—Yes, the water will only fall eighty feet, and will have to lift twelve hundred feet. Then there is the friction in the pipe and the loss in the turbine. It is out of all proportion.

31. Then, if the turbine only raised water to an intermediate reservoir, and lifting from thence was done by electric power, there would be additional water power needed for the electrical current?—Yes. I do not think that the scheme would work. I should like to accentuate one or two things. All the water needed for Johannesburg could, I feel confident, be found in the dolomite. I have not been able to get areas of the catchment basins of the streams. If the Municipality or the people interested in the matter were to put a few weirs on the Klip River at Jackson's Ford, on the Mooi River at Gemboksfontein, and at Wonderfontein and Steenkoppies, the water that flows over the weirs in a twelvemonth would be known. The rainfall could be carefully registered, and compared with the water that flows away. If then some six or seven feet of loss by evaporation were allowed per annum, we should be able to calculate the quantity of water which had sunk in the dolomite and which was available for pumping. I have been told (I do not know myself if any careful gauges have been made) that when the Zuurbekom pumps lift one million gallons or less, the discharges of the Mooi and Klip Rivers are

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not affected at all. If this is the case, it means that there is in the dolomite area, which we have around Johannesburg, an enormous reserve of water from the town to draw from. It would be a pity when Nature has put all this water so close at hand to go farther afield.

32. Of course, the terms of our reference includes the supply of water from Boksburg to Krugersdorp?—A pipe will be laid, I presume, along the whole Rand by the Municipality, or the body dealing with the water supply, which will sell by meters to the different towns and mines along the Rand, and let each body distribute as it pleases.

33. That involves forcing the water from Krugersdorp to Boksburg?—Yes.

34. How do these two places compare as regards levels?— Krugersdorp Station is 5,690 feet, and Boksburg (at least from the figures which Mr. Melville, of the Goldfields Company, was kind enough to furnish me) 5,340 feet.

35. It therefore comes to this, that on the average there is a slight fall down to Boksburg?—Yes. Springs is, however, 5,370 feet, which is a little higher than Boksburg.

36. For economy's sake one would desire to put the water into the higher level instead of pumping against it?—Unfortunately for the East Rand they have no spring water there, and consequently all water must come from this side.

37. From the higher level which is the natural basin?—Yes. If you take water from the Klip River, and the same from Gemsbokfontein, and Wonderfontein, and Steenkopjes, in fact from wherever you obtain it by means of a pumping station you could let it flow in one stream, or in two or three. The pressure would be maintained by the high level reservoir.

38. Could you help us in regard to the respective costs, which will have an important bearing on the settlement of the matter?—The cost will be commensurate to the height the water will have to be lifted, and the number of miles the spring is from the place where it joins the main pipe or pipes. You can always make a comparative estimate, even when you cannot make a definite one.

39. There is a factor quite outside our cognizance at present, and it is the rights which may have to be acquired?—These will have to be gazetted out. I think a proclamation issued by Lord Milner would settle that matter in one minute. I come from countries where such rights are not known. In Spain, in Italy, in Egypt, in India, and other arid and semi-arid countries, the State looks upon all water, in rivers, in streams, in springs, and in torrents as its property. It is the first source of revenue of the State, and everything is subordinated to it. That is the custom in the arid and semi-arid region of the East, and I think it is a right one. In the West, where water is considered more or less as a nuisance, different laws prevail, but in the arid countries I think that all water should be the property of the community. The future prosperity of the whole of South Africa depends on the realisation of this fact.

40. I think, Mr. Willcocks, we may sum up by saying that, in your opinion, you are satisfied that there is a water bearing area round about Johannesburg sufficient to supply all possible needs without going to the rivers for supplies?—Yes, and to make quite sure, if I can get a better map than the one which I have here, I would take the catchment basement of each stream, and calculate approximately the quantity of water available. I could then tell you what might reasonably be expected from the dolomite area. I will later on send this report to the Commission in writing for their information.

Mr. Lance (of the firm of Messrs. Lance and Hoyle, Legal Advisers to the Johannesburg Town Council) put the following questions through the Chair:

41. You have referred to forty gallons per head of the population as being, in your opinion, a sufficient estimate?—No, I said that that figure was based on the report of a Medical Commission which sat in Johannesburg in 1896.

42. Do you know what points that Medical Commission considered?—I only know the result of their investigations, and this was considered the minimum allowance for the people of Johannesburg per head per day.

43. But do you not take it that those figures are arrived at for the consumption of water for domestic purposes?—No, for every purpose whatsoever.

44. Can the doctors say what is wanted for engineering purposes?—They consider that a part and parcel of the whole thing. They have considered all that, for the streets, for the sewerage of the town, and for everything that is necessary. All that is included in the forty gallons.

45. And you think that the medical men are competent to form an opinion?—Yes. We always accept their decision.

46. Now, have you noticed the position of affairs in the town of Johannesburg as regards streets, as to whether there is a larger or smaller proportion here as compared to other towns?—Yes, four times as much.

47. That would be an element in considering the amount of water required?—I do not know. I do not suppose anyone would use water very much more than they do now.

48. In a dry climate like such as we have in this town, we have to do a lot of street watering, and if there are four times as many streets here, then naturally we want four times as much water?—But forty gallons per head is a sufficient allowance, and you can, if your streets are too wide, plant trees down the sides of them.

49. Supposing we have more streets than we have got now?—I think forty gallons per head per day is quite enough.

50. Do you know the quantity laid down in other South African towns for the consumption per head per day, say, for instance in Durban?—No, I do not know.

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51. We have ascertained from the statistics obtained from that town that the quantity allowed is forty-eight gallons per head per day?—I suppose Durban does not lift the water to the height you do. When people get water cheap they are generally inclined to waste it.

52. Do you know the quantities used in American towns?—Some use one hundred gallons, and Rome (in Italy) has, I think, as much as six hundred gallons; but, I think, in a dry place like this, where water is exceedingly dear, that it would be the greatest pity to waste it.

53. Then you mean that forty gallons per head per day is enough, considering the matter from the economical point of view?—Yes.

54. I have statistics from a large number of American towns, and they seem to average something like one hundred gallons per head per day. Do you know any reason why it should be more in American towns?—Where water is cheap large quantities are used, and waste follows, but you people here in Johannesburg are in a very different position. You are on the top of a high hill, and you have to pump your water up which is expensive, and while you do not have sewage and use meters you will never spend forty gallons per head per day.

55. Surely you are contemplating that we shall have sewers?—I am contemplating sewers and meters.

56. Then your estimate of forty gallons is not enough?—Forty gallons is far in excess of all requirements to-day, and will be ample with sewers provided you have meters.

57. Are forty gallons sufficient if we get a sewage scheme?—Yes. If you gave so much water a month to the people free they would only waste it, but if you give it to them through a meter they will be economical.

58. Well, now on what do you base your estimate of the population of Johannesburg?—Everybody says 100,000. I do not know who took the census, but everybody to whom I have talked on the subject has told me that in times of peace the population is about one hundred thousand.

59. And you estimate that it will possibly double itself?—I only base my calculations on what people say. It looks, however, as if it ought to double itself.

60. You do not claim any special knowledge about that?—Absolutely none.

61. You speak of these different supplies of water as being apparently inexhaustible?—Yes.

62. Those large sources of water supply you have spoken about?—Yes.

63. Can you give us some data for that?—Well, people who have been here fifteen years say the sources do yot alter, and in years of drought, do not diminish appreciably as compared with what they discharge in years of good rainfall. If I can get hold of a large scale map, I shall take the catchment basement of each stream, and I shall be able to tell approximately, from comparisons with other countries, how much water sinks into this dolomite, for none finds its way through the strata which bear the gold. The whole of it must be available for the water supply of the town.

64. Can you give us any data, Mr. Willcocks, as to what proportion of the water you think sinks into the soil as compared with that which goes away in rivers?—For instance, take East London. where they have gone into the question with very great care.

65. You mean East London in England and not in the Cape Colony?—Yes, that is so, in England. There they get an average rainfall of 25 inches. They have a minimum of 17 to 18 inches, and a maximum of about 32 inches. Therefore the rainfall in that part of the London district and Johannesburg is about the same.

66. But there is something difierent in the nature of the two rainfalls. Ours is generally in the shape of thunderstorms, but in London, I suppose, it partakes more of a gradual state of affairs?—Yes. There is this difference, that the dolomite here is very porous. The facility with which water enters into the dolomite caverns outweighs the fact that the rainfall comes in storms and not in gentle showers. The East London Company find that about three or four inches sink into the ground and feed the springs they draw upon.

67. Have you considered the point of experience here as regards some water supplies that have shown that pumping has led to their practical exhaustion?—They began with the wrong strata. They did not strike water-bearing rocks. When they have entered the dolomite, they have found no tendency to diminution.

68. You know that the Bezuidenhout Valley supply near the town has, to a large extent, became exhausted?—Which valley is that in, please?

69. It is just outside the town.—Is that in the dolomite?

70. I do not know.—It was presumably mere surface water, and had nothing to do with the dolomite supplies.

71. You have considered the point then that in some cases the supply has failed?—To the best of my ability I have, and I consider the dolomite supplies sufficient for all requirements, but as I said before I shall hand a final report to the President after I have calculated the catchment basins.

72. Mr. Willcocks, you spoke of riparian rights just now as being gazetted away in a very easy manner. Do you know anything of the legislation dealing with that subject in a country like Italy?—When Victor Emmanuel conquered the whole of Italy, one of the first Proclamations he made was that all streams, torrents and water were Government property, that is, the property of the community, the Government representing them. Subsequently to that he appointed a very strong Commission to enquire into the whole question including all the concessions from the earliest times. New, reasonable, and substantial concessions were then given, but nothing was allowed for riparian rights, because those rights had been brought into Italy by the barbarians from the damp and foggy north.

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73. Then our laws are those of barbarians?—Yes, we are the children of those barbarians, and consequently need to turn to the legislation of dry countries like Italy to appreciate the situation in this semi-arid country. Italy owes its prosperity to its wise legislation. You do not find in that country people sitting on perennial springs in the beds of rivers and preventing the community from making use of them.

74. With regard to the question of the number of gallons per head per day, you spoke of Cairo just now. Could you tell us the quantity allowed there?—They take so very little, that I am almost ashamed to tell you. The water is very dear there, it is sold at stands, and the poor have to pay highly. We used to make out that the rich and well-to-do people took one hundred gallons per day per head; but there were no meters. These people paid so much a month, whether they took large quantities or small.

75. Could you tell us what they paid for it there?—Yes, I can. Including filtration it cost 6d. per 1,000 gallons, and is sold at the stands at 4s. per 1,000 gallons, and in the houses at 2s. per 1,000 gallons. The water for the streets is paid for at 10d. per 1,000 gallons. You must remember, however, that at Cairo the water is not lifted to a fraction of the height you will lift here.

76. Do you consider that the surface supply from springs is any criterion as to the quantity of water that is obtained by sinking?—Yes. Considering that we have a pervious substance like the dolomite, traversed by impervious dykes (wherever we have an impervious dyke the water is forced to the surface), the water that rises to the surface is a gauge of the quantity, even if there are other streams flowing underground which we do not see.

77. Suppose, for example, the amount of water was twelve million gallons per day, and your outflow showed itself, do you think you would not get more by sinking?—You might if you sunk it at some other places. Of course, I have not gauged the streams for a whole year, but people who have been pumping at Zuurbekom say that their pumping operations have no effect on the springs. Dykes traversing the dolomite cut off their water they think from that on each side. I think, however, that there is communication between the well and the springs. If finally the water is exhausted it will always be possible to go to the Vaal River and take the water from there. When one can gather better water, higher water, and nearer water, it is a pity to begin by going far away to get it.

78. We want to know if the water supply is inexhaustible?—With regard to the statement that these springs are inexhaustible, and that they do not diminish year in, year out, I can only testify to what everybody says. I myself have been here only one month.

79. You told us about riparian rights in Italy, do you know anything about them in any other country, such as England?—That is not an irrigation country. We must carefully distinguish between arid and semi-arid countries on one side, and temperate countries on the other. The Transvaal is a semi-arid country.

80. So Italy is a better guide?—Egypt and India are not as good guides as Italy. There the Governments are too strong. But in Italy, we have a European people, such as ourselves; the people not only like these laws, but prosper under them.

81. Do you think the rights of individuals have been sufficiently considered?—Yes.

82. You referred to the Vaal River just now, and stated that one of the principal objections to that was filtration. Does this filtration increase the cost to any very great extent?—Not the principal objection. In Cairo we have two pipes in each street, one carrying unfiltered water for the watering of the streets and the gardens, and the other filtered water for drinking purposes.

83. Does it make very great difference in the cost?—Yes, at certain times. For example, when the water is muddy it makes a good difference in the cost.

84. And how about the maintenance?—When I was in Cairo we had the muddy water to filter for some months every year, and occasionally found it very difficult to filter the necessary quantities sufficiently quickly.

85. You could not form any estimate as to the amount?—I cannot do it now, but I could if I had my books. I used to make a calculation every month.

Mr. Thomson (of the firm of Messrs. Solomon and Thomson, appearing on behalf of the Johannesburg Waterworks, Estate, and Exploration Company), put the following questions through the Chair:

86. Do you know Mr. Willcocks, the extent of this dolomite formation?—Yes, I have a very good map of it by Mr. Molengraaf.

87. And you are aware that this dolomite formation in the Transvaal is one huge sponge extending right across the country?—Yes.

88. And that it would naturally collect all the water along the Witwatersrand?—Yes, and a great part from the other side. because the dolomite not having powers of resistance. forms valleys between the higher hills on both sides. The only place in South Africa like this which I know is in Oudtshoorn district of the Cape Colony, where they have the some dolomite formation and the same plentiful supply from springs.

89. I understand you to say that you have been to Zuurbekom?—Yes, that is so.

90. From the indications at Zuurbekom do you think that that is an inexhaustible supply?—I say that it seemed to me to be one great underground cavern full of water connected with the Klip River on the one side and the Mooi River on the other.

91. Through the whole extent?—The engineer told me that whether he pumped much or little the water remained at eighty feet. If this is the case it is a very strong spring.

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92. So you came to the conclusion——?—That some of the water flows into the Mooi River and some into the Klip River, and the Zuurbekom Pumping Station is midway between them.

93. It would really be simply a question of pumping appliances to supply the whole quantity required from that point?—I do not think you could supply the whole from there, I should also supply from other springs, such as Wonderfontein and Steenkopjes.

94. To speak of Johannesburg for the present. From what you saw at Zuurbekom, do you think that the water there would supply the whole of the place?—No, not the Rand Mines.

95. I am talking about the town of Johannesburg?—Well, up to the present Zuurbekom has given perfect satisfaction; but not being a visible spring no man could prophesy to what extent you could draw upon it. It would be only a guess from the statement about this water, that when any quantity under one million gallons is being pumped per day there is no appreciable difference in the height of the water.

96. That is sufficient evidence?—No, it is not sufficient evidence. It is only encouraging.

97. You cannot say that because it supplied one million gallons per day that it could supply two million gallons?—Certainly not, though it might.

98. Still, in your opinion, the whole of that dolomite basin is full of water?—Yes, it is like a big sponge. And if one got into any difficulty with the springs at one height one might bore deeper and see if there were not springs at a lower level.

99. And, of course, the nearest point to Johannesburg where we can find this would prove to be the most economical supply?—A few miles more or less would not make much difference.

100. Are you aware, Mr. Willcocks, of what the consumption of water has been in Johannesburg?—I have been informed about a million gallons per day, and sometimes more.

101. And the pumping capacity at Zuurbekom is capable of being trebled?—Yes, the capacity of the pumps, but the water remains to be seen.

102. Did you measure the pipe at Zuurbekom?—No, but they told me that it was a sixteen inch pipe.

(*Mr. H. C. Hull*, representing Mr. Goch) to the Chairman: I find myself in a somewhat difficult position, as Mr. Willcocks has not inspected the water scheme in which we are interested, and I would like to reserve my questions until he has seen the Wonderfontein water supply.

(*The Chairman.*) I am afraid you will never have the opportunity of examining Mr. Willcocks again.

(*Mr. Willcocks.*) If you ask me any questions now I shall put them down, and answer them after seeing Wonderfontein.

103. (*Mr. Hull*, through the Chairman.) Have you read the Transvaal Concessions Commission Report on the Wonderfontein Water Supply?—I do not think I have read it very carefully.

104. You have not read it specially?—I read it through ordinarily, but not very specially.

105. Were you not struck by the enormous supply of water there?—Well, when I first read it, I said to myself "I would like to measure the water there." That was the first feeling that came across my mind when I read it.

106. (*The Chairman.*) It is certain that you must leave before next Monday. There is no opportunity of continuing your stay?—No, I must leave.

(*Mr. Hull*, to the Chairman.) Is it possible to get the Commission to sit again before Monday next, in order to hear Mr. Willcocks, because it naturally prejudices our case, as we shall not have a proper opportunity of examining Mr. Willcocks?

(*The Chairman.*) I am afraid it will be impossible for the Commission to meet until Monday next.

107. (*Mr. Hull*, to the witness—through the Chairman.) If you found that there was fifty cubic feet a second of water at Wonderfontein what would you say?—I should say it was extraordinary.

108. Supposing you found that you got thirty million gallons per day there?—I should say it was extraordinary. I do not think it would be safe, however, to have the water supply of Johannesburg in one spot. To have such enormous wealth dependent on one place, where any wandering Boer or some enemy might hurt it, and upset the whole of the water supply is not advisable. Of course, these fears may be groundless, but it would be very unsafe to have the whole of this enormous wealth dependent on one place, and that so far away.

109. Will you pay special attention to the question of riparian rights if you visit Wonderfontein?—Lord Milner will do that, not I.

110. I want you to be good enough to study the question of riparian rights in order to see whether any riparian question will occur at Wonderfontein?—Yes, I will look into the question with pleasure.

111. In regard to the dolomite scheme, how many wells do you think it would be necessary to sink in order to supply all requirements anticipated?—I should go to the spring as well as to the wells.

112. How many approximately will you have to accommodate this?—There is Steenkopjes. If that gives ten cubic feet per second you can take five cubic feet from that source. That is one case. If the Klip River gives ten cubic feet, we can take five cubic feet from that. And in other springs in the neighbourhood I should take so much from them, Steenkopjes, Wonderfontein, head of the Mooi River, and head of the Klipriver, and Zuurbekom, that is midway between the two. Exclusive of Wonderfontein there would have to be four pumping stations.

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113. You do not want to consider riparian rights at all?—No, I do not want to consider that question at all. I look on the value of the springs as quite distinct from the riparian rights. In my opinion a man who lives half a mile away from a river has as much right to it as the person who lives on it. Of course we are in a country where water is a very valuable commodity.

114. (*Mr. J. W. Quinn.*) Are there any other objections to taking a supply from one source besides the danger of being interfered with as you suggested?—Of course, if one source can give the whole supply that is required, and that one is absolutely reliable, and granted that nothing would happen, I would not see any objections. But accidents are so liable to happen and the quantity of water that is in the neighbourhood is so enormous that I think it would be one of the greatest pities in the world.

115. Is there any danger of the dolomite formation being cut through here and there by dykes? Would that be one of your reasons to objecting to take all the water from one source?—No.

116. With regard to a source such as the Zuurbekom source, in your opinion would there be any danger?—Yes.

117. Suppose we were to tap this side of Zuurbekom, and also the other side do you think such an arrangement would interfere with the Zuurbekom supply?—It certainly might, because the water must come from somewhere, and it would be very difficult for any man to say on the top of the ground where the water travels underground; but one might strike the parent reservoir elsewhere.

118. The figures you gave us just now in regard to the levels would seem to point out that there would be a lot of water in the district. Is there therefore the possibility of that weakening the supply of Zuurbekom?—It certainly might be weakened by another bore tapping the same spring elsewhere.

119. It is a factor to be reckoned with?—Distinctly so.

120. (*Mr. A. Brakhan.*) The extent of the catchment area and the slope of the catchment area are important points to be considered?—The fall would be ordinary, but this spongy dolomite seems to take nearly everything that goes into it. The first thing that water does when it falls in Johannesburg is to run down the slopes and then flow over the dolomite. The surface of the dolomite is corrugated, with all the corrugations full of sand. This sand drinks up the water and then the water filters down through clefts in the dolomite.

121. Do you know whether any rainfall on the central formation drains away from the dolomite to the south-east, for instance the hills east of the Natal Spruit?—No, I cannot tell, as I have never been on those hills in a storm.

122. Do you include the southern hills in your catchment basin?—Yes, I consider them a part of the basin. Any man who has been there in a storm could tell you with certainty, but I think that all the rain water of both sides of the valley goes into the valley.

123. Having once got into the dolomite it may escape?—That is possible, but not likely I think, as the impervious dykes stop it.

124. I think you said that the mines would require twenty-five cubic feet per second, which is roughly speaking about fourteen million gallons per day. And then I think you said half of that was obtained from dams?—More than half, if not the whole, is obtained from the reservoirs and dams to-day, but I think that for so important an industry it would not be safe in years of bad drought to count on more than half.

125. On the other hand that quantity which can be obtained from dams is limited because extra capacity for storing in dams virtually does not exist?—Yes.

126. At present this half would be a very ample figure, but later on it would be reversed?—Yes, that is so, later on you would need nearly the whole.

127. At present, of course, the quantity of water wanted outside of the quantity stored in dams has not been very large so far?—No, I have thought that a great part of this extension was not only to secure an ample supply for existing works in a year of drought, but also in order to encourage people to extend their works without nervousness. If the water were available at a cost of 2s. 6d. per thousand gallons, in order to wash out a sovereign, you would only spend eightpence on the water, which expenditure I consider small compared with the absolute necessity of having the water available. Obtaining the water seems to me to be the cheapest part of the whole work. You have your sovereign and your water for washing out comes only to eightpence, even if it costs 2s. 6d. per 1,000 gallons. The Waterworks would be an insurance well worth your while to pay. Supposing, through any scarcity of water, the mines had to stop work for three or four weeks, there would be a great loss of money to Johannesburg. I should not at the beginning lay one big pipe sufficient for all demands in the future; but lay a second pipe later on if necessary.

128. (*Major W. A. J. O'Meara, C.M.G., R.E.*) Have you ever seen the Proceedings of the Geological Society of South Africa, in which Mr. Draper expresses his theory in regard to the Zuurbekom supply?—No.

129. Well, Mr. Draper's theory appears to be that at Zuurbekom a very large basin has been eroded in the dolomite, and that has been filled up with sand and material of that description. That being the case, he calculates that the whole of the water which falls over some forty square miles of country goes into that basin.—He guesses a good deal. This water feeds the Klip River, the Mooi River, Zuurbekom, and other springs. The Goldfields Company have a pump and well in the same basin far away from Zuurbekom, and they get all they want from this

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well. The whole subsoil seems to me full of water everywhere. You need only tap it at the right place.

130. Again, taking Mr. Draper's figures that the annual rainfall (twenty-four inches) which goes into this basin is equal to 13,381 million gallons; this being so, would it naturally follow, having in view the fact that the water in the bore-holes referred to remains at the same level when such a small quantity as one million gallons only is being taken away daily, that the supply is unlimited?—It would not naturally follow, but it is very difficult to ascertain by merely walking on the ground as to what is underneath. That can only be done by pumping.

131. Supposing again that Mr. Draper's theory is correct and that the water falls to the east and west from the Zuurbekom basin in the dolomite formation, would you expect to get an unlimited supply in the portion of the dolomite formation east and west of this basin?—I should think that if you went far enough you might strike the water. But I must say that I was not there long enough to know.

132. (*Mr. G. Rouliot.*) If I understand you correctly, you say that there is in this dolomite formation a vast amount of water which is practically unfailing, and that water is forced out in certain points which make these streams flow east and west. Is that the idea?—Yes.

133. You would rather be in favour of taking water where it is apparent than risking to go under ground and falling into a basin which would be exhausted?—Yes.

134. From your examination of local conditions, have you any idea at what price water could be sold?—Everybody says from two shillings to two shillings and sixpence.

135. That is not of your own knowledge?—No. It seems to me that when you have to pump at great distances and heights and in such large quantities that any expert who was accustomed to such works on a large scale would be able to give you information on that point which would be much more valuable than my opinion. I am not an expert in that line, certainly not on such a scale as yours. I personally do not think that the price of 2s. or 2s. 6d. for such height and distances is expensive for 1,000 gallons of water. Kimberley is much higher.

136. (*Mr. B. Kitzinger.*) In your opinion it is not advisable for Johannesburg to go in for a drainage scheme?—No. You are on the top of a hill and the sewerage water will flow into those streams from which you draw your drinking water, and however much you purify the outflow it will certainly contaminate your springs in time. I consider for a place like Johannesburg that the dry earth system is safer and healthier than a water scheme. And then, moreover, if you have a water sewerage scheme and you sell water by meters I do not think the place will be as sanitary as it is to-day. In case meters are used the people will use the water with great care, and anything but a very liberal use of water in localities subject to long continued droughts will lead to unhealthy conditions.

137. So you consider a sewerage scheme would be more a source of danger than a boon to the place?—Yes, I do.

138. Would pumping water at Zuurbekom affect the supply at Wonderfontein and *vice versa*?—In regard to the springs of the Mooi River at Wonderfontein it seems to me that they belong to a lower stratum of water altogether than the water at Zuurbekom and the Klip River. There may be some connections, but I think they are separated by dykes of impervious rock, and pumping water near the sources of the Klip River would not reduce the springs at Wonderfontein or Steenkopjes.

139. (*The Chairman.*) We might say that your opinion is that there are many independent sources in the dolomite, and that within the limits of the dolomite you can pick and choose?—Certainly.

140. As a practical man you would, in selecting your particular sources, be chiefly guided by what you had to pay for them?—Yes.

141. *Mr. Thomson* (through the Chair.) What difference in consumption would there be per head in case there was a sewerage system and in case the present system was continued?—With meters or without?

142. With meters?—It would depend on the habits of the people. All I can say is that there are no people so attached to meters as the French, and yet in Paris, where they have both meters and sewers, the Water Engineer told we that he was sure there were diseases in Europe to-day which could almost be traced to the people stinting themselves in the matter of water supply owing to the meter. He added that unless people were allowed to waste water they would never use enough of it.

143. (*The Chairman.*) The upshot of your answer is that you really cannot answer?—I cannot because it depends on the habits of the people, and I do not know the people.

(*Mr Thomson.*) I based the question on the statement of Mr. Willcocks. He estimated forty gallons per head per day.

(*Mr. Willcocks.*) I said the Medical Board of 1896 did. I took their figures and I thought them ample.

144. (*The Chairman.*) Have you had any experience of the meter with the minimum, such as is in operation in Capetown?—No, I have no experience of that system.

The Commission then adjourned.

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WITWATERSRAND WATER SUPPLY COMMISSION.

MINUTES OF EVIDENCE.

SECOND SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

MONDAY, 25TH NOVEMBER, 1901.

Present:

G. V. FIDDES, ESQ., C.B., SECRETARY TO THE TRANSVAAL ADMINISTRATION (CHAIRMAN).

A. BRAKHAN, ESQ.,
B. KITZINGER, ESQ.,
W. McCALLUM, ESQ.,
W. ST. JOHN CARR, ESQ.,
J. W. QUINN, ESQ.,
G. ROULIOT, ESQ.,

G. CRAIG SELLAR, ESQ., SECRETARY.

(*The Chairman.*) I should like to say that if any gentlemen are preparing statistics for our use, they should give them in gallons. We are getting rather upset by cubic feet, centimetres, litres, and so on, and it will be a great convenience to us if all the statistics are uniform. Before we proceed any further, I may say that Mr. Willcocks has put in two letters as appendices to his evidence, the first being about the Wonderfontein source, and the second about the catchment area of the Klip and Mooi Rivers, and I think it would be as well if the Secretary read them.

The Secretary read the communications, which were as follows:—

Mr. W. Willcocks C.M.G.

November 25 1901.

145. WONDERFONTEIN.

On Tuesday, the 5th November, accompanied by Mr. Goch I inspected the Mooi River as it traverses the Wonderfontein property. I had anticipated seeing springs, but found instead that opposite Oberholzer Station, on the Klerksdorp railway, the Mooi River is traversed by a granite or diorite dyke, and lower down by a thick belt of chert. The granite dyke is visible on both banks of the river, but in the river's bed it is lost in a marsh full of tall rushes and water. The water oozes up in the bed of the river along the length between the granite and chert dykes (indeed in England such a river would be called "the Ouse"), and when, after hundreds of feet of impenetrable rushes and marsh, you see the water hurrying across the belt of chert which is visible in the bed of the river overgrown with bushes and weeds, you find that the discharge of the river has increased from 9 or 10 cubic feet per second to four times that amount. What the discharge exactly is cannot possibly be measured without a weir or training channel. The quantity of water is not under 35 or 40 cubic feet per second.

A little lower down the whole supply disappears, I understand, in courses in the bed and sides of the river. I have seen the river which traverses the Topolias swamps in Greece, and which has the same discharge nearly as the Mooi at Wonderfontein, do exactly the same thing. Closing the mouths of these caverns at Wonderfontein, and, keeping the whole supply in the bed of the river would be an easy and profitable task for the Government.

The riparian rights at Wonderfontein seem to me far more visionary than riparian rights elsewhere. Indeed, the very great discharge of the river at this place would make the stream as part of the public domain if anything could. The larger a river, stream, or spring, the more surely is it public property.

(Signed) W. WILLCOCKS.

6-11-01,
Johannesburg.

146. Capetown,
November 12th, 1901.

Dear Sir,—To the best of my ability I have calculated the catchment basin of the Klip and Mooi Rivers, the former up to Kroonvlei, where it takes a right angular bend to the south of Johannesburg, and the latter to Wonderfontein. I have left out the area where water is tapped by the Rand reservoirs. The area comes out to 540 square miles. Now if 3 inches per annum enter the dolomite, we have the quantity which is stored per annum as over 3,500,000,000 cubic feet. The springs discharge between them some 60 cubic feet per second or 2,000,000,000 cubic feet per annum. This leaves 1,500,000,000 per annum as the reserve water capable of being drawn from independent wells as it escapes from channels other than the springs.

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Now, Johannesburg, with 200,000 people, and the Rand Mines producing £40,000,000 per annum, will require 53 cubic feet per second or 1,700,000,000 per annum.

We may say that the dolomite water will suffice for everything. Mind, I have left Steinkoppies and its area out altogether as I cannot understand the map in that catchment basin.

Mr. W. Willcocks C.M.G.

November 25 1901.

Yours truly,

(Signed) W. WILLCOCKS.

To the Secretary to the Water Commission, Johannesburg.

WONDERFONTEIN WATER SUPPLY.

Mr. GEORGE HENRY GOCH, called and examined:

Mr. G. H. Goch.

November 25 1901.

147. (*The Chairman.*) Mr. Hull, this is your witness. It would assist the Commission if you would lead his evidence.

148. (*Mr. Hull.*) Very well. (*To witness*): You are the holder of certain grants by the Government of the late Republic and of certain agreements made with yourself, which constitute the Concession commonly referred to as the Wonderfontein Water Concession?—Yes.

149. These agreements formed the subject of inquiry by the Concessions Commission some months ago?—Yes.

150. And are referred to in the Blue Book published by the Imperial Government?—Yes.

151. I understand, Mr. Goch, that you have prepared a list of the documents constituting your title?—Yes.

152. Will you hand in that list?—Yes. I hand in a document showing thirteen different contracts and one set of letters.

Memorandum of Contracts, etc., relating to Wonderfontein Water Supply.

Marked:

(*a*). In red, 1st, Dutch official printed copy of the Concession.

(*b*). 2nd, Notarial contract, 17th September, 1892, ceding Concession to G. H. Goch.

(*c*). 3rd, Another Notarial contract 24th February, 1893, ceding further rights to G. H. Goch.

(*d*). 4th, Notarial contract 19th February, 1897, ceding way-leaves over farm Roodepoort.

(*e*). 5th, Notarial contract 17th February, 1897, ceding way-leaves over farm Doornfontein and De Pan.

(*f*). 6th, Notarial contract 14th July, 1897, ceding way-leaves over farm Witfontein.

(*g*). 7th, Notarial contract 22nd July, 1897, ceding way-leaves over another portion of Witfontein.

(*h*). 8th, Notarial contract 30th July, 1897, ceding way-leaves over another portion of Witfontein.

(*i*). 9th, Notarial contract 14th July, 1897, ceding way-leaves over one portion of Elandsvlei.

(*j*). 10th, Notarial contract 20th July, ceding way-leaves over another portion of Elandsvlei.

(*k*). 11th, Official copy of contract of October 6th, 1896, between Government of late South African Republic and G. H. Goch.

(*l*). In black. 12th, Original contract between State Secretary Reitz and G. H. Goch, relating to increase of capital and enlarging works, March 2nd, 1899.

(*m*). In red. 13th, English translation of correspondence between Government of late South African Republic and attorneys acting for G. H. Goch, covering period 28th February, 1893, and March 26th, 1898, inclusive.

(*n*) 14th, Notarial deed of servitude registered on the titles of the owners of Wonderfontein.

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153. (*Mr. Hull.*) These start from the original agreement made by the late Government with the Oberholzers, the subsequent agreement that you made, and also the way-leaves?—Yes; also my way-leaves for the pipes.

154. The originals of these agreements you are prepared to submit to the Commission for inspection?—Yes.

155. You have also some reports by engineers. I would like to have Mr. Way's report first?—Yes, I have reports bearing upon the supply of water at Wonderfontein.

156. Way, I believe, was your engineer, appointed by you?—Mr. Way acted for me, and Mr. Sykes, the other engineer, acted for gentlemen in London who entertained this business at the time, and employed Mr. Sykes to measure the water on their behalf. We have the two reports here with diagrams.

157. Would you be good enough to read them?—Yes. The report from Mr. Way——

158. What is the date of it?—It is the 16th November, 1897.* It reads: "Acting upon your telegram of October 21st, and upon the results of several interviews with you, I obtained permission from my Directors to carry out your wishes, and arranged to proceed to Wonderfontein on Tuesday, November 2nd. Circumstances, over which I had no control, prevented me going at the last minute, but I was able to send a representative, who has done a considerable amount of surveying with me of the kind wanted and upon whose figures I could rely as if they were my own. I had previously arranged all the methods and principles by and upon which the survey was to be made, and it was only a question of obtaining accurate data and therefrom accurate results, to arrive at the information required. I decided after getting all the information possible that the only kind of survey possible was a 'float' survey and the necessary apparatus was prepared for

* See Appendix D. 1.

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Mr. G. H. Goch, November 25 1901.

it. . . . On the cross sections you will find the exact width and depth of the stream shown where gauged, and these measurements will be valuable to your client if at any time he wishes the variations in the flow checked. The season of the year could not have been more favourable for gauging the minimum quantity coming from the springs, as no rain had fallen since the last rainy season. Consequently the figures given below show very accurately the minimum quantity of water obtainable at the driest season of the year. . . . ." Then follows a tabulated statement showing the total discharge in gallons per 24 hours from the streams severally and combined. He arrives at a total of 30,515,040 gallons, of which 9,028,800 is from the Wonderfontein Loop, and 21,486,240 from the Wonderfontein Spring. Then he goes on to explain the system of gauging.

Further on he says:

"On November 4th I handed you a statement to cable to your client, of which a true copy is below:—

"George Hesse, Esq.,
Johannesburg.

WONDERFONTEIN WATER.

Dear Sir,—I beg to report to you for the purposes of cabling to Mr. Goch that I have gone into Mr. Davidson's figures, and they show that the flow of water is as follows:—

	Gals. per day.
Discharge from Wonderfontein Spring	21,486,240
Discharge from Wonderfontein Loop	9,028,800
Total available ...	30,515,040

159. (*Mr. Hull.*) Then you have another report by Mr. Sykes?—Yes.

160. This is not a report obtained by you but by some gentlemen in England, whom Mr. Sykes represented here?—Yes. Mr. Sykes sent the report to James Simpson and Co., of London. These are the gentlemen who employed him, and this report was handed to me by Mr. Walter Hunter, whom I employed as consulting engineer in this matter. It is in the form of two letters.

161. They are addressed by Mr. Sykes to his principals in England?—Yes. Shall I read them?

Please.—This one is dated 8th November, 1897,* in which he says: "In accordance with your request I went out on Tuesday last to Wonderfontein to measure the water on that farm. Mr. Way was at the last moment unable to accompany me owing to an accident on the George Goch Mine. I, however, took his surveyor with me; he is drawing up a detailed report which will be sent to Mr. Goch for your use. I found it extremely difficult to get a suitable place for measuring the water, but our observations were taken with great care, and from what I could learn the water has never been measured with anything approaching the same accuracy on any previous occasion. On my return I cabled you as follows: 'Water at juncture 30½ millions, weather very dry,' and Mr. Hesse sent a similar cable to Mr. Goch, this is the result of Mr. Way's surveyor's calculations. I had them run out by an independent engineer with approximately the same result. Owing to pressure of business I have been unable yet to go carefully through the figures, but going through them hurriedly, make the quantity over thirty millions. . . . You will notice that in measurements Z and X, I have given you the mean time, the float used was two tennis balls united by a line, the one being weighted so as to travel about three inches from the river bed, the water at Y was too shallow to use other than as a surface float." Then in the second letter* there is a detailed explanation of the figures, and the summary accompanying it shows the result arrived at, which is practically the same as the other man's, only the total discharge is given as 30,038,000 gallons, being 500,000 less than Mr. Way's calculation. Deducting the water from the loop, which is 9½ millions, the total water rising out of the spring is given as 20½ millions. This is a little less than Mr. Way's figures.

162. Now, Mr. Goch, this would be a suitable opportunity of referring briefly to Mr. Willcocks' report on Wonderfontein. You accompanied Mr. Willcocks?—Yes.

163. Will you tell the Commission what Mr. Willcocks did towards ascertaining the volume of water?—Of course, we were there only about half an hour, and there was no attempt at measurement. We stopped at the loop.

164. By the loop you mean Gemboksfontein?—Yes. Perhaps if I hand in a topographical sketch you will follow me better.† You will find the springs are shown on that sketch. To approach the springs you cross the loop by the road, which will be on the old coach road. At this point we were on horseback. We stopped at the loop, and Mr. Willcocks asked me to ride into it with the horse, so that he might measure the depth of the stream as it wetted the horse's legs. Having done that he made a rough estimate of the width of the stream, and then threw a piece of paper on the stream and went down with the paper as a float to a certain mark which he had made before, and timed it; and from those data arrived at the conclusion that there were ten cubic feet running in that stream. Then riding round the fountain we came to the junction of the two streams. Here the water was very wide. Mr. Willcocks got on to a sort of temporary bridge on the centre of the stream and looked at the water, and apparently he judged it simply by observation, and then retired. There was no measurement made here. He did not do the same as at the other; so that his figures are simply an estimate of what he saw. There could not have been any time for measurements, because he was rather in a hurry to get back. Half-an-

* See Appendix D. 2.

* See Appendix D. 3.

† See Appendix D. 4.

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hour is all the time we spent there. I note that Mr. Willcocks in his report states that there cannot be less than 35 or 40 cubic feet per second. I asked him to go through and see the other portion of the stream, but he expressed himself as quite satisfied, and did not go. Put in that form Mr. Willcocks' estimate is undoubtedly a very conservative one, against which I ask the Commission to accept the accurate measurements which the two engineers I have mentioned have made.

165. Will you also explain to the Commission, Mr. Goch, about the misnomer of the river?—Yes. Mr. Willcocks calls it the Mooi River. In this country it is never called the Mooi River. Nobody ever does call it that; it is called the Wonderfontein Loop. As you will notice from that sketch, the whole of the spring disappears on the farm below, and there is no connection between that and the Mooi River. You will observe from the examination made on this question by the Committee, appointed by the Volksraad—it appears in the Blue Book—that the Committee have gone into this matter very carefully, and their report deals with this very point.

166. Will you refer us to the page in the Blue Book?—It is Part 3, page 286, of the Transvaal Concessions Commission's Report.* If you look at page 286 under No. 5, and you read the fourth paragraph of the report you will find that the Volksraad Committee say:

"One of the members of this Commission, in a separate report, has tried to prove that the water of the Wonderfontein Spruit again re-appears on the farms Turffontein, Kiel and Gerhardsminbron, where it forms the course of the Mooi River. This supposition is based upon the general geological characteristics of the country in that neighbourhood, and the uniform indication of the ground between Wonderfontein and the last-named farms. It was, however, forgotten to mention that there, where the water totally disappears, a small rising of the ground shuts off the valley, and according to our opinion the water is stopped in its further course westward. As the real conditions in this country have often contradicted the theories of the ablest geologists, and as there was no opportunity for a complete and exhaustive examination, we think, although we cannot declare it proved, that the water rising on the farms Turffontein and Kiel to be a separate natural reservoir which has its outlets near the spring of the Mooi River on Gerhardsminbron. To confirm our opinion we may note that though repeated attempts have been made to prove that the water of the Wonderfontein Spruit is the same as that forming the spring of the Mooi River, they have always failed. We have observed amongst the documents a petition from Potchefstroom, protesting against diverting the water from the Wonderfontein Spruit to Johannesburg, at the same time, however, also a resolution of the Volksraad, deciding to reject this petition." I may say that the distance between where the water disappears on this farm below Wonderfontein and where the Mooi River has its source is something in the neighbourhood of fifteen miles; so there can be no possible connection between the two streams as far as any one can judge from any known information. The reference to the Volksraad Commission arises from a special attempt made to prove the connection and to back up a petition by which riparian owners on the Mooi River attempted to frustrate this concession on the ground that it would affect their riparian rights. They were, with our permission, allowed to go into the caves where the underground river runs, and into that stream they poured a bag-full of small corks and colouring matter. They then proceeded to this spring at Turffontein where they supposed this matter would make its appearance, and spun nets across the fountain in order to pick up any of the corks or colouring matter that would come along staining the net. After waiting there for a week they gave it up as a bad job, and wrote a letter to the Volksraad Commission admitting this, but asking that the law should be made so that I should have to prove that this water did not flow into the Mooi River before I took the water away. This, of course, was laughed out of court.

Mr. G. H. Goch. November 25 1901.

167. There is a stream called the Mooi River?—Yes. You will find it in the maps rising in the north and running down south; and you will find that where the Wonderfontein water disappears and where the Mooi River rises is fully fifteen miles apart.

168. You have also two reports from England dealing with the analysis of the water?—Yes. I consulted Sir William Crookes and Professor Dewar of the Royal British Institute, as two of the greatest authorities on this question, and submitted to them the analysis made by Dr. Kleiner in connection with the Government inquiry here, and they reported as follows:

*"We have read and considered the report D. 1 of the Government Committee on the water supply for Johannesburg,† given on pp. 285—290 of the report of the Transvaal Concessions Commission, dated 19th April, 1901, Part III., Appendix of Documents, and more especially have maturely considered the inferences to be drawn from the various analyses in Appendices A. and B.,§ p.p. 288—290. Inclusive of the Pretoria water, analyses of nine separate samples are given, and these analyses all seem to have been carefully executed by Dr. Edward Kleiner, of Pretoria. We say that of the eight samples (excluding that from Pretoria, of which the analyses are given) the water from Wonderfontein, marked III., is in our judgment undoubtedly one of the best, and in general character it closely resembles in composition the Pretoria water, which is admitted to be unexceptional in quality. Further, the fact that the Wonderfontein water is from a spring, rising in the

* See Appendix B.

* See Appendix D. 5.

† See Appendix B.

§ Not printed.

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Mr. G. H. Goch. November 25 1901.

dolomitic formation, and of such an exceptional character as to actually yield as much as twenty-six million gallons per diem, is sufficient to explain its freedom from organic matter, and the general degree of hardness and total solids, which in this water are not excessive. From a consideration of the geological map we see no reason why the spring water at Wonderfontein should not be completely isolated from any possible contamination from the spruit water, which may be polluted more or less by drainage from the mines on the Rand. If this spring is impounded and conveyed in the manner suggested in the Government report, to Johannesburg, we consider that city will be in the very fortunate position of possessing a supply of potable water of very high quality and in enormous quantity, entirely derived from deep springs, and therefore giving no anxiety as regards organic contamination or the presence of injurious microbial organisms."

I may here explain that the quantity of water they mention was based on an estimate, which subsequent measurements have corrected.

169. You have also had a plan prepared showing the proposed route of the pipe mains from Wonderfontein to Krugersdorp, Johannesburg, and Boksburg?—Yes, this is a plan—(*put in**)—showing the farms over which the pipes would travel. The farms intervening between the intake and the proclaimed goldfields I have secured contracts over. Accompanying the plan are the survey sections showing the elevation all along the route—(*put in*).†

170. Have you another plan showing the caves and holes at Wonderfontein?—That is on the topographical plan I have given already.§

171. Will you explain to the Commission what supply of water you have in addition to that mentioned already?—Amongst the contracts we have the right to the water in the caves. The original Concession confines me to one-quarter of the flow; but you will find the entrance to the cave marked somewhat to the north of the stream. Within that cave there is an immense body of water flowing in a northerly direction. It is a constant-flowing river. That is undoubtedly partly fed by the holes which I have shown on the margin of the river in the caves, but in addition to that this dyke, referred to by Mr. Willcocks as crossing the fountain, must have breaks underground which causes water to flow in the caves from an easterly direction probably somewhat parallel with the fountain. By entering the cave you will come on the margin of a vast area of water, which no one can measure. The quantity obtainable from this source it is difficult to say—it is difficult to ascertain what there may be—but I should think it is almost impossible to empty that cave. It lies very much below the river; the level of the river is considerably higher than the cave itself, and this river, which flows underground, we could never measure, because of the difficulty of the approach by reason of the mass of water lying around it. And so there is a vast quantity of water there which is available, and which could be added to the supply at the junction. I could not give you any estimate of the quantity because it is almost impossible to measure it.

172. You speak of the cave as a closed cave?—No, there is an open entrance to it.

173. Underground?—Yes, you can go down to it by an entrance which is like an incline shaft, but very irregular.

174. It is rather a subterranean river than a pool?—Yes, it is flowing, but you get to the edge of what is like a pool. At the last inspection I made I could not get to the river, but the river is well known however. In previous years I managed to get to the river, but it is rather a formidable task. In explanation of the plans I have handed in, it will be observed that the elevations are such that from the Krugersdorp heights the water will flow along the main reef to Johannesburg, and as we know Boksburg is lower, it will flow all the way to Boksburg. As regards Johannesburg, it would be necessary to land the water on one of the high hills in the neighbourhood, and as this is only twenty-three feet lower than the Krugersdorp heights, it will be necessary to pump up the water required for town supply and land it safely at a point from which it can be distributed over the town.

175. Now, Mr. Goch, that finishes the technical part of the scheme. In your agreements with the Government you contemplate supplying a much smaller quantity than is now required?—Yes, I estimated for three million gallons, and made an agreement with the Government to supply that quantity.

176. Three million gallons per day?—Yes. But Mr. Willcocks in his evidence has thrown quite a new light on the subject, and shown that a very much larger quantity is required. He arrives at fifteen million gallons per day as the amount that would be required for the town and the mines, that is, four millions for the present population, four millions for an increase to double the present number of inhabitants—that makes eight millions for the town; and then of the fourteen millions which he estimates as being required by the mines, seven millions, one-half, is obtainable from the present sources—hence seven million gallons would be required. That makes fifteen million gallons per day in all. The quantity is so great that it seems to me that special provision will have to be made if it is desired that it should be brought from Wonderfontein; but I propose to deal with only ten millions at present, and on that basis I have calculated as to the financial requirements of a scheme of that sort. I adopt this line chiefly on the suggestion of Mr. Willcocks, because in answer to a question—127—he said he would not at the beginning lay one

* Not printed.

† Not printed.

§ See Appendix D. 4.

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big pipe sufficient for all times, but would lay first one pipe and put down a second one later on if it was necessary. Therefore, I think it would amply meet the requirements, as far as our scheme is concerned, if ten millions are taken. I am not bound by this figure, however. Whatever the Commission may think may be necessary will be done. This quantity, combining the caves, I am quite sure we can supply. Without touching on the water in the cave, Mr. Walter Hunter has given me a sketch of what ought to be done with regard to taking the water from the flow of the river. He proposes in the rainy season to take a larger quantity from the stream and store it in a reservoir at Krugersdorp, and during the dry season to take exactly one quarter from the stream. Mr. Hunter's report says:*

"In accordance with your request, I now put into more formal shape the suggestion which I made in my letter of July 24th, that upon the terms of your present concession there should be no difficulty, with the assistance of a storage reservoir of moderate capacity, in supplying an average quantity of 10,000,000 gallons daily from Wonderfontein Spring. When the combined streams were gauged in the first week of November, 1897, when, to quote the words of Mr. Way, 'practically no rain had fallen at Wonderfontein' since the previous wet season, the total quantity passing was 30,500,000 gallons in twenty-four hours, which would permit under the concession an abstraction of, say 7,500,000 gallons daily, which would be the minimum quantity available."

Then follows a statement showing that the probable surpluses and deficiencies which may be expected in a year. The surpluses amount to 497·05 million gallons and the deficiencies to 197·5 million gallons. The report continues:

"The storage required is therefore 200 million gallons net, and if to this be added fifty per cent. to allow for extra demand for domestic purposes during the hot season and for evaporation, a reservoir of 300 million gallons capacity will be required, to fill which during the wet months 500 million gallons will be available. The additional capital expenditure necessary will be that due to the cost of the reservoir and to the increase of the engine capacity from 10 million gallons to 13·5 million gallons daily. The interest upon this extra expenditure, with a slight additional cost for maintenance will be the only additional revenue charge, as the cost of pumping, except so far as is necessary to make up waste for evaporation, will not be increased. In regard to my suggestion that it may probably be desirable to construct the proposed reservoir near Krugersdorp so as to have water available should any accident happen to the first two lines of main, I am glad to hear from you that the configuration of the land near that town provides the opportunity of making the reservoir with a comparatively small expenditure of capital. Referring to your alternative proposal to take water from the subterranean supply, over which you have a right to a surface area 200 yards square at the entrance of the lake, this may prove to be a valuable adjunct to the supply. I am of opinion, however, that it is desirable, at any rate in the first instance, to rely upon the spring alone in conjunction with a storage reservoir for giving the required supply."

Mr. G. H. Goch. November 25 1901.

177. Now, Mr. Goch, during your examination by the Transvaal Concessions Commission, it was suggested to you by the Chairman of the Commission that you should consent to your agreements being modified upon the lines of the English Waterworks Clauses Act?—Yes, I have considered that. The Waterworks Clauses Act of, I think, 1847, subsequently amended or added to by another Act of 1863, provides in the most complete manner for the control of waterworks companies. Every detail that can be considered or can be conceived in connection with the management of water works is controlled by those Acts. The public are in the fullest measure protected against any sort of irregularity on the part of Water Companies by those Acts, and the profits of the companies are so regulated that the public cannot be mulcted in too heavy rates for water. Whenever the profits exceed ten per cent. on their capital the balance over ten per cent. must be divided equally between the ratepayers and the company, the ratepayers receiving their share in the shape of reduction of rates, the Water Company accumulating their share as occur in future years—thus equalising them—and for other purposes for the benefit of the concern. At any rate, I may point out as a general effect of the operation of these Acts, that Mr. Willcocks in his evidence stated that in the East End of London water is supplied cheaper than anywhere else in the world. If that is so—and I have no doubt that coming from Mr. Willcocks it is the fact—then it is owing solely to the operation of the Waterworks Clauses Acts, which prevents the Directors of Waterworks Companies charging for their water more than is necessary to get a fair return on the capital which is invested in the concern, and I may point to that as a practical demonstration of the great fitness of the Waterworks Clauses Acts being applied. I am quite willing that they should be applied to this enterprise.

178. Well, now, I notice that under your agreements, Mr. Goch, that the late Government had power to appoint two directors on your Water Company, and also a Government Commissioner. I notice in the terms of the reference to the present Commission that a part of their inquiry is to ascertain the best means of constituting a Water Board?—If it should meet with the approval of the Commission that a company should be established, I consider that under the arrangement that the Government should have the appointment of two directors or commissioners on that Board, it would really constitute, with the Board of Directors, a

* See Appendix D. 6.

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public Water Board, because in addition to the obligation of the Water Clauses Acts, which control it as a public concern, there would be an additional influence in the advice and control of the two Government Commissioners acting with the directors. The Board of Directors, as being personally interested, will secure for you the best possible management that any concern can secure. Personal interest is the motive you will have as controlling their policy, and the Government Commissioners, armed with the provisions of the Water Clauses Acts, will be in a position to exercise effective control. That to my mind constitutes an ideal public Water Board, whereunder the public will be protected in every shape and form. Should this line be followed, of course, it follows logically that certain alterations will have to be made in my contract in order to fit in with the intention, the tendency and the policy of the Waterworks Clauses Acts, and also with a view to enlarged financial requirements of the scheme, because under the existing contracts, which only contemplate three million gallons, it would be quite impossible to carry out a scheme of ten million gallons; and therefore certain provisions will have to be made in that way to modify these contracts. I have thought out how it should be worked, and if the Commission would like me to state that I will do so.

179. (*The Chairman.*) Yes, you had better do so if you can give it us briefly.—Following on the adoption of this policy it would follow logically (1) that we are to alter the agreements in such a way that there shall be absolute security for the investors who will be asked to supply the funds for carrying out so costly a scheme. (2) That Government assistance be extended for financing the scheme; that at present arranged (*vide* D. 8 and D. 13, Part III., of the Report of the Transvaal Concessions Commission), being inadequate in view of the great enlargement of the plant to ten million gallons per day instead of three million gallons.

179*a*. Before you go to No. 2, No. 1 is rather vague. Perhaps you will explain it?—The point that struck me in connection with that is this—to secure in every way investors who will be asked to supply the funds for carrying out the scheme. In the present Concession there are certain restrictions which are rather arbitrary, and which I know have been objected to by investors in London; and I have made it a special matter of request to the late Government that they should alter in some measure some of these clauses. The Concession makes provision for the compulsory supplying of water under such arbitrary rules that under certain conditions the Government might even forfeit the Concession, which, of course, is entirely unreasonable—unreasonable because under the new conditions there is such ample provision made in the penalties which the Waterworks Clauses Acts give them the right to impose that the necessity for this clause of the Concession entirely drops away. I may turn up Clause 4 of the Concession, and give its terms to you more particularly; you will find it on page 291 of the Report of the Transvaal Concessions Commission, Appendix of Documents; it reads:

"4. If, in the course of the whole term of the Concession, the water at any time does not come up to the standard, or if the water reservoir or the means of conveyance prove to be insufficient for the requirements, to the decision and judgment of the Government, then the concessionaires are obliged to make, at their expense and as soon as possible, such works, and to take such measures as may be considered necessary by the Government, to make provision in that respect.

In case the concessionaires remain in default to execute said works as soon as possible, or to take the prescribed measures, then the Government has authority to have this executed at the expense and risk of the concessionaires, or the Executive Council, by virtue of that authority reserved to it in Art. 27, may declare the Concession cancelled."

I wish to point out that as a general provision Art. 30 of this Concession stipulates that all questions in dispute shall be settled by arbitration. It is on page 294, and reads as follows:

"30. All differences with regard to the stipulations of this Concession and the application thereof between the Government or its officials and the concessionaires or their officers which cannot be settled amicably, are decided by three arbitrators, who, as good men, without form of process, will decide in the highest resort.

Of these arbitrators, one will be nominated by each of the parties, while these two arbitrators before commencing to deal with the differences will select an umpire.

If they cannot agree in the choice of an umpire, the latter will be pointed out by one of the Judges of the High Court.

In all cases requiring conjunction between the Government and concessionaires, a difference will be considered to have arisen if no agreement is arrived at between them."

That, of course, provides some protection under this clause, but the words imported into Clause 4—that on a question of the quantity and the quality of the water supplied the decision rests with the Government—conflicts with the intention of Clause 30, and makes it somewhat difficult for investors to view the agreement with complacency, and we have approached the previous Government with a view of having that clause altered. On this very question of the quantity and quality of the supply, you will find that the Waterworks Clauses Acts make the fullest provision and stipulates the penalty which will be imposed under such circumstances. Hence, it seems to me that the words imported into that clause should be taken out, and that it should not be left to the judgment and decision of the Government; but that we should have recourse to arbitration, and

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that the penalty should not be confiscation. That is one of the clauses we wish to draw your attention to as logically involved in the position now suggested on which I should be met.

179*b*. You do not mean, when you speak of securing the investor, guaranteeing him a minimum rate of interest?—Not at this point, but I have that suggestion to make too. You will find that in the agreement subsequently made with the late Government (D 8 and D 13, Part III. of the Report of the Transvaal Concessions Commission), there is a provision for £20,000 as a guarantee for the shortfall of interest on the concern. In view of enlarging the scheme so very much I should suggest that this assistance should be extended somewhat and that instead of enabling us to have provision to issue, as it was then contemplated, half-a-million of debentures, we should be put in a position to issue debentures to the amount of £750,000. The extension is not a serious one, because the extra guarantee only amounts to £6,250 per annum, I think, making it £26,250 in all. This would enable us to issue debentures under such a guarantee undoubtedly at 3½ per cent., which will be covered by the amount I have mentioned. That is, I think, not an unreasonable request to make in view of the enlarged scope of the scheme. Moreover, under the management suggested, any saving that can be made in the financing of the scheme in the way of diminishing the annual fixed charges will be a direct benefit to the consumer.

180. You only want another £250,000 in debentures to increase your supply from three to ten millions?—That is all. But then we must have further power to issue preference shares. Our financing will require two millions. We propose to issue £750,000 in debentures secured as I suggested, £750,000 in preference shares, and then our ordinary capital it is suggested should be £500,000. But whatever else might be the case, it must be for the profit of the consumers if the fixed charges are paid. The public will know exactly what the Water Company can make out of them under these conditions. The general idea is that it will carry out the scheme from the intake at Wonderfontein to Boksburg by a main service pipe of sufficient dimensions to supply the quantity of water required for the mines. Whatever the town will need will be delivered to them in a reservoir on one of the hills, and from that point they can deal with it as they like. Of course the scheme involves that the town as a consumer, if they desire us to supply them, should say the minimum quantity it will take, because obviously if we put in an installation involving a cost of two millions sterling, and if the quantity as arranged for is ten million gallons, and that quantity is not taken, the cost of every thousand gallons will be increased. If the full quantity is taken the cost per thousand gallons will, of course, be at the minimum, but in proportion as that quantity is not taken the cost rises rather rapidly, so that it is in the interests of the consumer if the town can decide as to what it will take, and you can base your scheme exactly on these requirements. And the same applies exactly to the mines.

(*Mr. Hull.*) That is all I have to ask the witness.

181. (*The Chairman.*) Mr. Goch, before I ask you any general questions, I wish to ascertain this. I understand you referred to the 1895 report,* which refused to recognise any connection between the Fountain and the Mooi River. Who signed that report?—The signatures are attached.

182. I think it is J. M. A. Wolmarans?—Yes, Wolmarans is one, and I think Weirda is another.

183. Weirda ought to have signed it, but he appears to have accidentally omitted to sign it. Are either of those gentlemen geologists?—I do not know what their qualifications are.

184. Do you know who the dissentient was who wished to establish a connection between the two?—Probably it may have been Weirda, as he has not signed the report.

185. I merely wanted to know. You alluded once or twice to taking water from the "river," as you call it. I suppose as soon as you take water from the river, by which you mean an open stream, you would necessarily be taking surface water as well?—No, the spring is so close to the point where the measurements took place—that is, the junction of the two streams—that there is really no drainage into that part. Let me make it clear. If you refer to the junction on this sketch map of the fountain and the stream,† the proposed intake will be there, but it will not absolutely draw the water from where the two streams join; the suction pipes will be put into the fountain close by, and thus you secure your water always pure.

186. Nevertheless, you have high ground running down on both sides of that fountain, and so you must be having surface water rushing down this ground. You could not probably avoid some of it going into the running water?—No.

187. You are not in the same condition as if you were drawing the water from the dolomite by a shaft?—Of course it is quite possible to make a drain all round the fountain, and so keep your fountain perfectly clear. That is, of course, perfectly feasible.

188. As regards the English Waterworks Clauses Acts, I am not sure that I followed what you said. Do you state that since they have been enforced the interests of the consumer have been so perfectly protected that everything has gone perfectly well, and that the consumers and the Waterworks Companies have no points of issue between them?—I did not say that; but I said it was a great protection to the consumer, and I instanced the evidence of Mr. Willcocks as showing that East London gets its water cheaper than almost any town in the world.

* See Appendix B.

† See Appendix D. 4.

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189. I suppose the same Acts are in operation all over London and all over England and yet we have had some frightful controversies in England with reference to water supply.

190. (*Mr. Hull.*) Pardon me, it is not quite so. Certain of the companies have their own private Acts. These Waterworks Clauses Acts only apply to companies which have not got private Acts.

191. (*The Chairman.*) And is East London one of those regulated by these Waterworks Clauses Acts—do you assert that, Mr. Goch? —I think these Acts apply to all those water companies where they are not in conflict with their special Acts; and where there is no provision in the special Acts on certain points the Waterworks Clauses Acts come in.

192. You said you asked the late Government to alter Clause 4?—Yes.

193. What was the result?—We were put off.

194. They refused to alter it?—No, they did not deal with it. I believe that in one of the letters they asked that it should be postponed.

195. There is a letter here, Part III. of the Report of the Transvaal Concessions Commission, in which they say the rest of your request is refused, but they do not state here what is the request to which they referred. I do not think any documents have been put before the Commission referring to that request?—All the documents I put in before the Concessions Commission were not printed I notice. In the letter of March, 1898, this is what they state:

"And further not to agree to the remaining alterations asked for, but that should it subsequently appear that in the execution of the works it will still be necessary to refer to this matter again the Executive Council will be prepared to give their consideration to those alterations."

196. But surely that has nothing to do with Clause 4?—It refers to all the other alterations that were asked for.

197. You see it is an answer to your letters of 14th January and 8th February, but in neither of these letters, I think, is there any mention of Clause 4. Oh, yes, I see. At the end of Law 4 to add "provided, however, that the arbitration clause of Law 30 be applicable to this article." In other words you ask that you may not have your Concession cancelled without it being referred to arbitration?—Yes, that's it.

198. You have rather spoken all through your evidence so far as if it were a matter of course that your contract with the late Government will be recognised and acted on. I suppose you have not had any intimation from the Imperial Government as to their decision upon your Concession?—No.

199. Now, with regard to the original purchase by you of the rights of the owners of the farm Wonderfontein, you did not purchase anything except the water rights, I think?—No, barring land surrounding this fountain such as was required for the scheme.

200. Were the rights held jointly or individually by those owners?—Jointly.

201. There was no one owner who held one portion of the farm or water rights?—No, the farm is not a divided farm.

202. Because I have been told that there was a certain Hendrick Oberholzer on whose property the fountain is said to be, and that he was not one of those who sold his rights to you?—Oh yes, he did; you will find his agreement properly in order.

203. Then your purchases from the Oberholzers were made, I gather, somewhere between 1891—when I think the contract was made between them and the Government—and 1893, when you put in your first plan?—I think it was in September, 1892, I purchased from them.

204. Of course you made yourself well acquainted with the Concession the Oberholzers had got before you bought it?—Yes. You refer to the period of time within which the plans should be filed, because that was extended by the Government.

205. No, I am referring to Art. 26 of the Concession, which provides:

"The concessionaires have not the right to transfer this concession to others, or to allow others to participate in it, unless in respect of such actions the previous consent has been obtained from the Government. That consent is at once granted hereby for the transfer from the concessionaires to a company to be established for the purpose of executing this concession."

205*a*. Did you get the previous consent?—Yes, from the late Government.

206. But if you will recollect, the report of the Concessions Commission left that in doubt?—You will find the cession signed at the beginning of D 2: "Ceded by Notarial Deeds of Cession, dated 17th September, 1892, to and on behalf of George Henry Goch."

207. Is that to be taken as a previous consent by the Government to the cession? —The Registrar of Deeds could not act without the consent of the Government because the Concession itself states that he was satisfied that the consent was given when he made this endorsement on the contract.

208. Now, between your springs and Boksburg, of course you have to carry your pipe line as you have shown us, and you have acquired your rights of way, you said in your evidence before the Concession Commission, partly by purchase and partly by lease?—Yes.

209. Can you tell me what the duration of these leases is?—They will run concurrently with the Concession, and some are altogether without period—they run for ever.

210. None for a shorter duration than the Concession?—None for a shorter duration than the Concession.

211. As I understand, your plan includes the construction of three pumping stations, the laying of 47 miles of pipe line, and the building of at least three reservoirs?—Yes.

212. How long would it take to complete the work from the time you are ready to begin operations?—One likes to stipulate for

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as much time as possible not to make any mistake, but three years is ample to complete it all. I have estimates made of a very much shorter period. To be quite safe we will say we will be at Boksburg within three years.

213. In your dealings with the late Government you only asked for two years?—The original contract only stated two. We found that running it too close, and the Government modified it and made it three years.

214. Yes, three from the 22nd January 1897?—No. If you refer to Clause 9 you will find it says "Within 24 months from the receipt of the written approval of the Government, as described in Article 7, the concessionaires must have these waterworks completed in so far that the exploitation can be commenced." The 24 months have been increased to 36 months.

215. Take D 10. You write to the Government:

"With regard to our former application for an extension of time we take it that the alteration of the plans will operate as an extension of time and that the two years stipulated for in the concession will be taken from the date of the approval in the new plan, which would exactly meet our requirements for a year's extension. Please inform us whether the Government shares this view with us, and if not whether they will in any case agree to an extension."

In other words, it was two years from the date of the approval of the plans, but you want the year weeded out during which no approval had been given?—That is so. The approval referred to there has not been given.

216. The last approval of all?—Yes.

217. Instead of that I find that the last resolution of the Volksraad on this matter was that dated 12th July, 1898, in which they said that in the interests of the population of Johannesburg no further extension of time could be given to you for constructing the works. They use the phrase "exploitation," which other documents show means "supply water to the public"?—Yes, that is in reference to the extension given on March 26th, 1898, that no further extension must be given.

218. In other words, as I understand the matter, they contemplated that on the 22nd January, 1900, the thing would be finished?—You mean from the 22nd January, 1897?

219. 1898.—You refer to the approval given by the Government?

220. The point is this, that the sovereign authority in this country had then said that no further extension of time must be given. The date of that was the 12th of July, 1898?—The letter giving the extension of one year was given in March, 1898. The reference, therefore, of the Volksraad is to this extension previously given, beyond which no further extension should be given.

221. That still brings you to the 22nd January, 1900, as your final date for turning on the water?—No, because the case is governed by the approval of the plans; instead of reading "Within 24 months from the receipt of the written approval of the Government," it now reads "Within 36 months of the receipt of the written approval," the concessionaires must have the work finished.

(*Mr. Hull.*) And that period was increased for one year by the Executive Council.

222. (*The Chairman.*) As I understand the matter, but for the increase of one year by the Executive Council you would have had to finish your works on the 22nd January, 1899?—No, because they asked me to amend the plans prior to that. The amended plan was forwarded to them with the letter of 14th January, 1898, D 10. You will find it says:

"With reference to the desire of the Government to have altered the route of the proposed works under the above-named concession, we now have the honour to submit to your Honour a plan of the new route, and trust that same will satisfy the requirements of the Government."

After the Government had approved of the original plans in January, 1897, we received a letter from them, asking us to re-open the question of the plans already approved. I refer you to D 9, page 297, where the State Secretary writes to us:

"Before taking into closer consideration your request for an extension of the time for bringing the water from Wonderfontein to Johannesburg, the Government would be glad to know if Mr. Goch would be prepared to submit again to the consideration of the Government the plans already approved for the purpose of making amendments and alterations therein, such alterations then to be discussed between you and the Government and the Executive Council."

223. I see that perfectly well, but it does not meet my question, which is this: You said on the 14th January that "this will exactly meet our requirements for a year's extension if you take the two years to be two years from the date of the approval of the plans." The Executive Council reply that they have decided to extend the period by one year?—They did not conform to what we suggested in the letter, but they adopt the line instead of increasing the two years mentioned in Article 9 to three years.

224. Yes, I see the Executive Council reply to you that they "have decided to extend by one year the period within which, according to Clause 9 of the Concession of 2nd March, 1891, the Johannesburg Waterworks must be so far completed that a commencement can be made with the exploitation." Then, on July 12th, 1898, by 11 votes to 10, "The Raad resolves further, with regard to Point 8 *re* supply of Wonderfontein water, that it is desirable in the interests of the population of Johannesburg that the Government shall not grant any extension in the future." I read that to mean that the Raad, tired of the delay in constructing the works, resolves that whatever happens Mr. Goch shall not have an extension beyond the 22nd January. 1900.—I think you are quite wrong, if you will allow me

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to say so. May I submit it to you in this form? The Government's letter extends the period from 24 to 36 months. The period commenced from the time of the approval of the plans. The plans having been previously to this date approved of. and the question afterwards re-opened by the Government, we were. under another clause of the concession, expressly prohibited from proceeding with the work until the plan or any alteration thereof they desired, had been approved. Clause 7 provides:

"No commencement may be made with the execution of these works, before in that project these modifications have been effected and those conditions have been attached to the execution thereof. as the Government, in the general interest and if possible in conjunction with the concessionaires, may consider necessary and the written approval of project has been given by the Government."

225. I think that is merely your interpretation of this Volksraad resolution. I can understand your interpreting it in that way, but it seems to me equally open to the interpretation that the Volksraad turns round and says, "No, we can give no more than this."—To what can they have referred except to the letter of 26th March, and that letter gives an explanation of Clause 9, and then comes the operation of Clause 7. They ask us themselves to make alterations on these plans, which we handed in on the 14th of January, 1898. It is not our fault that they did not approve of the plans. There are many letters not published in the Concession Commission's report, and which I should be glad to hand in again showing the struggles we made to get them to approve of the plans. Even in the letter they granted the extension they did not approve of the plans until it was necessary for me to come out from England to get it done.

226. I can quite see that, but surely there is no cause for surprise that the Transvaal Government should go on in that way; it was nothing unusal for them to do that sort of thing—to pass a resolution that seems utterly inconsistent with the equity of the contract?—Yes, but I do not place that interpretation on this resolution. They referred to the explanation in that letter, and say that later they might give a further extension. They probably had not the facts before them, but at the same time this does not touch my point that my time, under this letter of March 26th, begins from the date on which the Government approves of the plans.

227. You ask that the two years may begin to operate from the date of the approval of the plans?—I did not ask it; the law gives it to me.

228. The original contract?—Yes.

229. When they ask you to re-submit the plans you again said that you took it that the two years would begin from the date of the approval of the new plans?—Yes.

230. Do you consider that was asking for an extension?—We wanted three years, and we got three years from the date of the approval of the new plans.

231. No, two from the date of the approval of the plans.—Pardon me, we have got here three from the date of the approval of the new plans.

232. I confess I never understood that. You ask in your letter that the time shall be two years from the date of the approval of the plans.—Supposing I take that view, that I must finish the work within two years from the approval of the new plans, do you wish to bind me down to that?

233. You do not understand this reply as saying that in the interests of the population of Johannesburg you should not be allowed any more time beyond the 22nd January, 1900, whatever the contract or anything else might say?—That I certainly did not understand, and I do not think anyone can put that construction on it.

234. Now you put in your plans, if I recollect rightly, somewhere in February, 1893, and it was not until 1897 that you got the Government's approval?—That is so.

235. Of course on the face of the documents it would look as if you had been letting the thing slide the whole time, but in a statement which you have put in before the Concessions Commission you gave very strong reasons for the want of success on your part in getting the thing pushed through any further, and I think it amounted to this—in fact you state it very clearly there that the root of the trouble was the opposition of the Johannesburg Waterworks Company?—Yes, I referred to that.

236. According to your evidence before the Commission they hired men to break up a public meeting on the water question, they spent over £3,000 in attempting to secure the control of the Sanitary Board, and, although you do not expressly attribute this to the Company, there was so much bribery in connection with the public meeting called to take a vote on your scheme that, in your phrase, you withdraw your offer. I do not quite know what the phrase means, but it does not matter.—You will find it in print in the Blue-book.

237. Yes; it is in part 2 of your statement. So that one may take it from that that there was a pretty good struggle going on all the time. I suppose you on your side were endeavouring to oppose or counteract these manoeuvres?—Certainly.

238. I suppose you approached the Government, although there is nothing before us on the subject, to get your plans approved of between 1893 and 1897?—No; the whole matter was in suspension in view of the steps taken by the Council to get a municipal supply, and this continued up till February, 1895, when the matter resolved itself into a vote to be taken by the townspeople. Then came in the irregularities that I complain of. My offer was all that time before the Town Council.

239. Will you explain to me what the offer was?—My Concession and its rights were offered to the town amongst others. There were a great many other offers besides mine; they were all before the town.

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240. Do I understand that at that time it was proposed that the town or the Sanitary Board should purchase the Concession from you?—That is so.

241. You had not gone so far as to form a company?—Yes, we had, but that stood aside until the Council decided what to do.

242. Was there an offer made from you? —Oh, yes.

243. Is it publicly recorded?—Yes, but I cannot recollect it now—it is many years ago.

244. Of course once your scheme was properly started, I take it things would go rather hardly with the existing company? I notice that in your evidence before the Concessions Commission you stated competition was a rather good thing, but you could not conceive a state of things in Johannesburg in which you would have two people conveying water to the same house? —I do not think there is any difficulty about that, especially since Mr. Willcocks threw so much light on the subject.

245. I am talking of then.—Then there might be. There was difficulty with the public as to competition with the Waterworks, and the Company was frightened of it.

246. At that time the Waterworks Company had not discovered the Zuurbekom source, and were supplying a peculiar and different kind of fluid?—That is so.

247. And if you came in they would practically be done with?—That I do not know. They are very well able to look after themselves.

248. I understood from your concluding remarks that you consider that the reference to the Commission would be met if they were to throw the water supply of the Rand, from Boksburg to Krugersdorp, into the hands of your Company, putting two Government Directors on the Board, and getting the Government to introduce legislation on the lines of the Waterworks Clauses Acts in England, by which the cost of the water to the consumer might go up or down indefinitely provided that the profits of the Company remained steadily at a minimum?—Yes; the company, of course, would be entitled to a certain profit—a reasonable profit—and there we are controlled.

249. You think that would answer the terms of reference as to a public body?— Well, I think so. I do not know what the Commission may wish to do. If you wish to carry it out as a public work entirely, that is quite another matter. I merely suggest this course as more feasible.

250. Of course Mr. Willcocks' evidence has shown that there is a very large supply of water in the neighbourhood of Johannesburg, and that there are several sources from which the Commission would probably get water; and, further, so far as the Commission is concerned it is not incumbent on them to go to Wonderfontein at all.—Quite so.

251. I mean even at the extreme point, supposing the British Government recognise your Concession, all it does is to say that you can take the water to Johannesburg, but it does not say that Johannesburg is bound to take your water. I am not sure that you claim exclusive right to one-fourth of the water. I have an exclusive right to the whole of the river.

252. I know that you have a clause that the Government will not allow the water to be taken by others within a certain area: "The Government undertakes to grant to no other person or persons, company or companies, the right to take the water from the Wonderfontein stream to the ground to the north-east, within the following lines." Do you suggest that that is operative against the gentleman who sold you the one-fourth right?—Yes, against everybody.

253. Then the people who once sold you the right to take one-fourth of the stream are debarred by the Government from selling the other three-quarters?— Oh yes, certainly; distinctly so.

254. I should rather have read the clause as against the Government—that the Government were not going to give another Concession on the same ground.—I purchased from these owners this concession with all its conditions, and they are bound by it.

255. You are very well acquainted with Johannesburg?—Yes.

256. You think that a solution such as you propose, a company—the Goch Company let us call it—would be a satisfactory solution to the Johannesburg public of the water question?—It is difficult to know what will satisfy the public sometimes. I should think if we can give them the water very much cheaper than they can get it to-day they will be satisfied.

257. And as this scheme contemplates the mines having to take water, the mines would be equally satisfied?—With the mines and the town consumers I presume it is only a matter of price—what they can get it for—and if that satisfied them I think the scheme would be completely satisfactory.

258. You do not know whether they would have any feelings that a scheme of this magnitude, on which the whole place depends for its life, should be in the hands of a purely public body and have nothing to do with a company?—If they think so, I have no objection whatever to urge. Only I suggest the formation of a company which could, I think, meet all their wants. It is rather a complicated affair supplying water to varying interests, such as the industrial interests of the mines and the domestic interests of the town. And a public body, I presume, will in future times be dependent on election, and then comes in the question of conflicting interests, which will be fought out at the ballot—a most undesirable thing in a question of this sort. The mines may be controlled by the town or the town controlled by the mines, and a great deal of dissatisfaction will result. It seems to me to meet the case far better that a company should be allowed to operate under the Water Clauses Act suggested, and acting with the Government through the Commissioners they appoint on the Board. The public will be served in that way just as well as they would be by having a Public Board; in fact, I think, better.

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259. And as cheaply?—And as cheaply.

260. More cheaply perhaps?—I think more cheaply, because as I said before the interests of Directors are personal, and they would economise far more cleverly than a public Board, whose interest is honorary.

261. I should like to ask you one or two questions about the financial part of the scheme, as you have put it before us as a thing we ought to take up. I looked at the figures given in the last part of your evidence before the Concessions Commission, and they rather puzzled me—I daresay from my ignorance of financial matters—and I should like you, if you would, to go through them with me and check any false conclusions I may have come to.—Which do you mean?

262. Take the end of your evidence, Question 4140. I suppose your preparation for the work has never got so far that a prospectus of the Company was issued?—I had the trust deed of the Company finished in 1898.

263. Not a published document?—It was not published, but we were ready to publish it.

264. There has been no public document issued in which the vendor's price was mentioned?—No.

265. In your evidence before the Concessions Commission you said that you would supply three million gallons a day, and the total cost of construction was estimated by you at £508,000?—That is the estimate made by Mr. Walter Hunter.

266. The authorised capital was a million?—Yes.

267. That left a balance of £492,000, which would cover vendor's price, the flotation and so on?—Not necessarily. It would have been reserve. That which was not spent would be the reserve.

268. At any rate it was there?—There was provision in it for such rights as it might be necessary to acquire. Do you mean that that was the price of my rights?

269. Not a bit; but there was that amount to meet those things which had to be provided. One may take it another way. which brings out somewhat the same result. In your amended contract with the Government you provide that £600,000 should be available for the purposes of the Company. Of course that is an elastic term; it might include the purchase price, but even if not between that and the million we get £400,000 available?—Yes.

270. Coming to the sort of way in which your scheme was to work out, the Concession provided that first of all you should take 12 per cent. of the profits for the shareholders and that 1 per cent. should go to the reserve fund. That 13 per cent. on half-a-million would be £65,000?—Yes.

271. Then the debentures would, I suppose, be 4 per cent. debentures?—Yes, that was the idea.

272. That is another £20,000. Then in your examination before the Concessions Commission, Mr. Loveday, I think it was, wanted to get the total annual cost of delivering the water at one place and the upkeep, and your answer to that was: "Between £60,000 and £70,000"?—Mr. Hunter's answer was. On page 243, question 4146, that was put to Mr. Walter Hunter.

273. Yes, that is the question. However, you put it at from £60,000 to £70,000 a year?—That is on the basis of a three million scheme.

274. Did you allow for depreciation?—Yes, it included depreciation.

275. I do not know the life of these waterworks, but I should have thought that you would provide more than that on a scheme costing half-a-million?—You mean on the debentures, perhaps?

276. No. Take depreciation.—Yes, depreciation was provided for in this scheme on the basis of seven per cent. on reservoirs and dams and five per cent. on pipes.

277. Then I take it that these three things with the possible exception of provision for redemption, would be your total expense?—Yes, it would be on that basis. The larger scheme of course would be different.

278. Yes, I am sticking to the scheme for three million gallons per diem. Well, so far, that gives £155,000 to provide for 12 per cent. interest to shareholders, one per cent. reserve fund, 4 per cent. on the debentures, and the provision for upkeep and depreciation. Now turn to the revenue side. You were going to provide three million gallons a day and your maximum price was to be 10s. at that time. You recollect before that your maximum price was 40s., and you had a sort of sliding scale by which you came down, very gradually indeed, from 40s. to 10s., but you never went below 10s?—No; 10s. was the agreement that the Government subsequently made.

279. It went from 40s. to 10s. Ten shillings was the maximum, and nothing was said of anything less?—That is so.

280. Ten shillings was, I think, the amount charged by the Johannesburg Waterworks Company?—Yes.

281. And is still?—And is still.

282. It would be a moderate estimate if you take the whole of your three millions at half price?—I think we calculated it at less.

283. But I suppose we may say it would not come out at less than 5s.?—You mean that to pay all that it would require 5s.?

284. No. Supposing you were drawing your prospectus now for the investor, you would be justified in putting down 5s. all round for the price?—Yes, I think, we would have been.

285. Seeing that Zuurbekom were getting 10s., that makes the revenue £274,000?—Yes; something in that neighbourhood.

286. The difference between those two sums the revenue and the expenditure—is £119,000?—It would have been, I daresay.

287. Well, I suppose that would have been the amount on which the Government would have claimed 25 per cent. under your concession?—Yes; on whatever the balance might have been. You reckon, of course, on the sale of the full three million gallons. which would hardly have occurred.

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288. No, but I have taken the price at 5s. and not at 10s. £30,000 would have gone to the Government and £89,000 would have gone into the pockets of the shareholders—always excepting whatever provision you were making for redemption of debt. That would be another 20 per cent.?—That is if we could have sold on this basis, but we had the competition of the Waterworks Company, which would have brought it down a great deal indeed.

289. On these figures it seems to me that the Company would be in an uncommonly good position.—Yes, it would have been a good company no doubt.

290. And the present Government merely by saying "we allow you to take the water from Wonderfontein to Johannesburg," would be fleecing Johannesburg of £30,000 a year, its share of the profits. I never quite understood why you make the Government instead of 10 per cent. of your profits take 25 per cent. The Government would have got £30,000.—That is assuming your premises are correct, that we got these prices. We never expected that we would get them. We proposed to enter into competition with the Waterworks Company, and the prices would have to be regulated on a competitive basis.

291. Wouldn't it be possible to come to a working arrangement with the Company?—Yes, that might also be done.

292. I daresay you notice that in one of your answers, Question 4144, you said the income would be £160,000. I could not make out where that was got from, but I think you might tell me now?—That was not my answer. It is Mr. Hunter's reply. He was in possession of calculations he made, and I think it is also possible that he thought that we might not be able to sell the whole quantity of water for which we put in the installation.

293. If we should recommend to the Government to adopt your suggestion, and hand the undertaking over to a company controlled by the Waterworks Clauses Act, do you consider that this figure of 12 per cent. should be maintained, or something higher or lower substituted, as the figure round which the water charges should oscillate?—In England 10 per cent. cumulative is allowed. 12 per cent. does not in this country seem to be excessive.

294. You think 12 per cent. would be rather moderate than otherwise; 10 per cent. in England ought to mean 20 per cent. here?—No, I think we would be satisfied with 12 per cent. It seems to me a very reasonable arrangement, seeing we keep our capital as low as possible. Our capital will only be £500,000. We propose to finance with preference shares and debentures, thus keeping the charges very much down.

295. There is only one subject on which I wish to ask you further. Will you turn to Part II., page 237, of the Concessions Commission's report? And this I want to ask you, not so much as representing this scheme, but as a man of great experience in mining operations. I will just read to you the paragraph; it is at the end of your memorandum, which was put in before the Concessions Commission. You say your source of supply practically stands without a rival, and continue:

"As regards quantity, the only source of supply which can compare with it is the Vaal River. But as the whole of the gold fields area drains into this river the water is contaminated by the industrial operations of the mining works, involving, as it does, in ever increasing degree the use of immense quantities of cyanide of potassium, rendering the Vaal River as a source of supply quite unfit."

Can you tell me how far up the Vaal, in your opinion, that contamination extends; would it be even above Vereeniging?—Yes, because you have the drainage of the gold-fields of Heidelberg from the Blesbok Spruit, flowing into the Vaal River.

296. And it is by the discharge from the cyanide vats or from the tailings finding its way into the sluits and thus into the Vaal, that this contamination would arise?—Yes.

297. Do you consider that the quantities of cyanide are in any case sufficient to exercise a certain influence over the water?—Distinctly so.

298. In quantities that analytical chemists could discover?—The difficulty is that the tailings taken out of the vats are piled up in heaps and the heavy rains wash out the poison, which would find its way into those streams. But in dry times this would not happen. It is, however, too great a risk to subject the public to.

299. You know the country beyond Vereeniging, I do not. How many miles up the Vaal would this contamination extend?—It is hard to say, but I think it would not be less than 30 miles.

300. And of course it is not only cyanide. There are other sources of contamination from the mines too?—A great industry like this must necessarily soil the water with which it deals so largely. It cannot escape it. I know that if Professor Crookes—and he is a man that deals with these things constantly—suggested such precautions until we could have shown him that the Fountain gave us a water free from contamination that might result at the Wonderfontein Loop—I know he would have condemned the Vaal River.

301. And then you go on to say:

". . . permanent charges for filtration which, according to the experience gained at Kimberley, is equivalent to about 3s. per 1,000 gallons, or on the basis of a 3,000,000 gallon daily supply for domestic purposes, requiring, if expressed as capital, a charge of £4,000,000, bearing 4 per cent. per annum, on the population served over and above the initial cost of the pumps and plant."

An enormous sum. I suppose the figures here are correctly given?—Yes. I have got the extracts from the Cape Blue Book of the evidence given by the Chairman, the Managing Director, and the Engineer of the Kimberley Waterworks, before a Par-

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liamentary Committee on this question. That is the price which it cost them to filter the water at Kimberley—another 3s. per 1,000 gallons.

302. Is it particularly turgid up there?—Not more so than here.

303. Your own witness told you that you should filter the Wonderfontein water?—Yes, but Professor Crookes told him it would be like painting the lily white, and he was quite reassured subsequently, and proposes now to do without filtration.

(*The Chairman.*) Thank you.

The Commission adjourned for Luncheon.

On Resuming,

(*Mr. W. F. Lance,* representing the Town Council.) I should like, sir, to put just two or three questions to Mr. Goch now, and ask if you would allow me to re-examine next week, or at the following meeting. In the meantime I could be going through all the technical evidence that has been given with the Town Engineer. Really the bulk of Mr. Goch's evidence is of a technical nature, consisting of reports, engineers' plans, and so on, and I would like to have an opportunity of going through these with the Town Engineer, and of examining Mr. Goch next week or at any time that would suit the Commission.

304. (*The Chairman.*) Would that suit you, Mr. Goch?—I am entirely at your disposal.

305. I thought you wanted to go away?—No.

(*The Chairman.*) Yes, I think we will meet you there, Mr. Lance.

(*Mr. Lance.*) Then I will just put one or two questions of a general nature now.

306. Mr. Goch, I would like to deal first with the quantity of water you have the right to take under your Concession. I gather that it is a quarter of the flow of the spring that rises on that particular farm?—No; a quarter of everything, of the whole river after Wonderfontein Loop has joined the spring.

307. So it includes the Loop?—Yes.

308. I think you admitted that in the water in the Loop there may be a certain amount of contamination from surface drainage?—Yes, it may be so, but that we propose to exclude by taking the water exclusively from the spring.

309. So that what you propose to deal with is what is estimated at about twenty-one million gallons a day?—No; we propose to deal with thirty millions a day.

310. I thought the thirty millions included the Loop?—We are entitled to one-fourth of thirty millions. In measuring we are entitled to take the water in the spring and the Loop, but the pumping of one-quarter spring alone.

310*a*. The yield from the spring is twenty-one million gallons, and of that you are entitled to a quarter?—No; I am entitled to a quarter of thirty millions.

311. No, but leaving the Loop out of consideration. Your proportion of what comes from the spring is a quarter of twenty-one millions?—No, I can take a quarter of thirty millions out of the spring.

312. Oh, I see what you mean. Then you claim that you have a right to take 7,500,000 gallons approximately out of the spring?—Yes.

313. And you propose to make that up to ten millions by a system of saving water when there is a surplus?—Yes; that's it.

314. Now, your scheme is to bring in a quantity of ten millions a day; and do I understand you to mean that that is for the supply of the mines and the town?—Oh, yes, it would be available for both.

315. In arriving at this have you gathered any data on which you based your estimate of the requirements?—No more than Mr. Willcocks' evidence, which shows immediate requirements of eleven millions plus four millions.

316. For the town?—No; the town eight millions and the mines seven millions.

317. Even then you do not propose to supply the whole of the town?—No. There is the Waterworks Company in existence; they would supply some too.

318. Did I understand you rightly to say that East London had cheaper water than any other town?—I understood Mr. Willcocks to say so.

319. I do not see it in his evidence?—I do not see it either. It has probably escaped notice, but I think it was generally known that he made the remark. It was in answer to a question of your own, I think, that he said the price in East London was cheaper than anywhere else.

320. I do not find it in the recorded evidence?—It may have been in a remark made, and not noted down as a question, but he said so.

321. This scheme of yours is for a company of approximately ten million gallons a day under certain legislative control on the lines of the English Waterworks Act?—Yes.

322. Do you think that comes within the scope of the reference to this Commission?—Well, I do not know how you can limit the inquiry. Anything that is relevant to the question can be brought forward.

323. Is that the only suggestion that you have to make?—No. I could suggest something else if you like. For instance, if the Commission decided that there is to be no company allowed but that it shall be a public work, then I am quite willing to treat with them on that basis.

324. Can you give us an idea what you would want on that basis?—No; I have not considered it. The question has not arisen. The moment I am told that is so I must decline to enter into further negotiations with the people who are willing to carry out the scheme, and then I am free to tell the Commission what I want.

(*Mr. Lance.*) That is all just now.

325. (*Mr. C. T. Thomson,* representing the Johannesburg Waterworks Company.) Mr. Goch, have you put in all Volksraad

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and Executive Council resolutions dealing with the question of your water rights?—Yes, I think so.

326. Are they all filed?—Yes, I think they are filed. I think there is reference made in the Blue Book to them.

327. The evidence given by you before the Concessions Commission included all resolutions?—I did not give any of these matters. The Commission searched for all resolutions in the *Gazette*, and found those there, and put them in as bearing on the case.

328. What I want to know is whether this Commission is in possession of all resolutions of the Volksraad and Executive Council dealing with your Concession?—I do not know.

329. You put in certain documents, and I wish to know whether they comprise all resolutions dealing with this matter?—I cannot tell you, but if you think there are any omissions, tell me and I will say.

330. I cannot say, but you are in possession of them. Have you a certified copy of the resolution of the Volksraad dealing with the extension?—What extension?

331. The extension of the extra twelve months.—No; I have no more than is in this Blue Book.

332. And you cannot say whether that contained in the Blue Book is a correct extract or not?—No.

333. Are you aware that one of the proprietors from whom you hold this lease disputes your contract on the ground that you have not carried out the terms of the Concession?—No, I am not aware of it. I have had no intimation.

334. Now to come to the cost of this scheme. What do you say you consider the cost of bringing the water to Johannesburg would be?—Which scheme do you refer to?

335. On the ten million basis.—The cost? I make provision for two millions in all.

336. Of which how much would be expended in actual work?—That I cannot tell you. I have no definite technical information on the point yet, but in a rough way it has been indicated that to deal with the cost in a proper way the capital I have mentioned should be provided.

337. But how do you arrive at the figures of two millions unless you have some data to go on?—I have this data, that for pipes alone—to Boksburg—the cost would be something over £800,000.

338. That is from Wonderfontein to Boksburg the cost of the pipes would be £800,000?—Yes.

339. The cost of pumping from three stations—what do you estimate that at? It is reckoned that there would be three pumping stations; what do you put that down at on a rough estimate?—I have no information to give you on that point yet. You must understand that this ten million scheme was only a recent one.

340. Well, let us go back to your old scheme, which was for three millions, I believe. What was the capital of your suggested Company on the basis of three million gallons?—It was £500,000 in ordinary shares and £500,000 in debentures.

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341. At what rate?—The debentures?

342. Yes.—Four per cent. was the suggestion there.

343. And with that capital you proposed to incur an expenditure of how much?—The actual cost came to £520,000, I think it was. At the time the estimate was made, in 1897, I think——

344. Does that include only your mains up to the reservoir, or does it also include distribution?—Yes, it includes distribution—46 miles of pipes in the streets of Johannesburg. If you will refer to Mr. Walter Hunter's evidence before the Concessions Commission, you will find he said 20 per cent. had to be added to those figures on account of the increased prices, which would make it close on £700,000.

345. And at what price did you estimate to deliver the water?—The calculations are given there. The £70,000 would have been the cost altogether, I think, for the delivery of the three millions.

346. How much per thousand gallons?—I have not calculated it.

347. I would like to know the price that the water would cost delivered here in your main reservoirs, per thousand gallons, and the cost at which you proposed to sell it to the public?—Well, I could not tell you that now. I have forgotten, because that scheme is dropped. I have gone into a very much larger one.

348. Can you give us the approximate figures on the increased scale at the adjournment?—The cost of delivering what water?

349. The cost of delivering the water at Johannesburg and the price at which you proposed to sell it.

(*The Chairman.*) I do not wish to interrupt you, but he has surely given you that information in answer to my questions, Mr. Thomson. We have had it that he proposed a supply of three million gallons a day; we have had it that the cost of delivery would be £70,000 per annum, so that it is really an arithmetical sum to arrive at the cost. If you have any point to make, I do not wish to interrupt you, but it seems to me that he has already answered your question.

350. (*Mr. Thomson.*) What I wanted to get at is to know in connection with this scheme of ten million gallons what arguments you have, Mr. Goch, to show that it would be for the benefit of the town and the mining community——

(*Witness.*) As compared with the existing Waterworks?

351. (*Mr. Thomson.*) Not compared with any other scheme, but based on your own figures, so that the Commission can decide for themselves on the figures you give, whether it would be a beneficial scheme or not?—Yes, I can give you that. I find that on page 281 of the Concessions Commission's

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Report, Part III., there is supplied by the Waterworks Company statistics showing what it cost them.

352. Yes, but the Waterworks Company are very much nearer; they have not the same distance to pump?—Yes, certainly. Allowing for all that, and taking the figures as they have given them themselves, the statement shows that for the year ending 30th June, 1899—that is a clear year before the war broke out—they supplied 426 million gallons to the public, of which 311 million gallons were for town consumption and the rest for street watering and mining. They show that the revenue collected amounted to £111,823. For that water thus they received an average price of 5s. 3d. per thousand gallons, but the consumer in the town knows very well that he pays 9s. The working cost is given on that page for the same period as £65,203, and there is a foot-note saying that this is exclusive of debenture interest, depreciation, and bad debts. The cost, therefore, on that basis, excluding those very important items, comes to 3s. 0¾d. per thousand gallons.

353. Is that for your scheme?—I am speaking of yours now. I want to compare it with what I propose to do. Of course you cannot carry on waterworks without providing for these important items of debenture interest and so on. Therefore, I take your debentures, amounting as they do to £250,000 at five per cent. That would add another 7d. per thousand gallons to the cost. Then you have redemption, which I put at the low figure of one-and-a-half per cent., and four per cent. for depreciation on £300,000, which I take to be the value of the dams and plant you have. Together these items would add another 9d. You have, therefore, 4s. 4¾d. as the cost of the water you are supplying to the town.

354. Now compare that with yours?—Yes. I propose to supply the town for half-a-crown, and in that half-a-crown will be included my profit on the capital, depreciation, debenture interest, and interest on preference shares.

355. (*The Chairman.*) On a minimum consumption of?—Of course the consumption must be on the basis of what I am going to supply, that is ten million gallons, the town taking a certain quantity and the mines taking a certain quantity.

356. (*Mr. Thomson.*) How do you base that calculation?—How do I base it? I say I am going to sell it for half-a-crown. The difference between half-a-crown and the 9s. which the consumers now pay, will effect a saving, supposing the town only takes half what I am going to bring, of £591,125 per annum. That sum, if capitalised on the basis of 4 per cent. will amount to £14,828,000, the burden of which they will be rid under my scheme.

357. Is that rate not on 10 millions?—No; it is 5 millions only for the town consumption.

358. How do you arrive at these figures? You cannot give the expenditure it would involve to bring in the water?—Yes, I give it to you: I say I will sell the water for half-a-crown. My profit and everything is included in that, so you can reckon yourself what it will cost me. On that basis I will be giving the town consumer nearly four times more water for the same money that he is paying to-day.

359. Can you tell us at the next meeting how you propose making up this capital of two millions? You say you are not in a position to give the proposed expenditure on pumping at the three stations, pumping along the Reef, and distribution?—No, I am not prepared to give you that yet. It is a difficult thing to get at.

360. Surely you can give us some approximate estimate? You have been ten years on this Wonderfontein scheme and you have granted options to people in London.—The larger scheme has only developed since I returned to Johannesburg.

361. Yes, but compare the expenditure with that on the smaller scheme.—The cost of the three million scheme is very different to the cost of the 10 million scheme.

362. Can you get it from your engineers by the next meeting?—I can give you an approximate thing. If the Commission desires to have an approximate estimate we can furnish it. It is a serious thing to bind yourself to an estimate of what it will cost to do a thing like this, on so short a notice.

(*The Chairman.*) I don't think we should press you on that, Mr. Goch.

363. (*Mr. Thomson.*) I want to know precisely what your obligations are under your Government agreements.—I do not know what you mean.

364. What do you have to give or what do you have to provide?—What for?

365. There is a contract between yourself and the Government.—On the face of it you can see for yourself what it is.

366. There are three different agreements, and I want to know now if you will digest these three agreements and let us know what your obligations are.—In what respect?

367. As to what you are to provide. You are to get certain consideration from the Government.

(*The Chairman.*) I think if Mr. Goch objects to that question he ought not to be pressed to answer it.

368. (*Witness.*) I really do not understand the question. What my obligations are is shown in these documents, and Mr. Thomson can find it out for himself.

(*Mr. Thomson.*) I have them before me, but there are others who have not and do not know what the stipulations are.

(*The Chairman.*) Perhaps you can put it in another way. You can mention the obligations and ask Mr. Goch if he agrees. It is all a matter of public documents.

369. (*Mr. Thomson to witness.*) How much water do you undertake to provide in your agreement with the Government?—Of course, I am limited to one-fourth of the flow of the river. I have shown how I can make up the supply to 10 millions by storing during the rainy season. There is, however, a provision in the concession—I refer to Clause 6—in which it says that if I have

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not a sufficient quantity for the public requirements the Government undertake—in a negative form, it is true, but it is there—to allow more to be taken. You will find that under the previous clause I am under very heavy penalties—in fact the cancellation of the concession—if I do not supply the quantity required.

370. What is the quantity required; that's what I want?—Let me finish, please. Under Article 6 there is this provision:

"The water will be conveyed in such quantity as will be necessary for the public service and the inhabitants during the whole term of the Concession. In case the quantity allowed to be taken under Clause A of Art. 1, will be found insufficient, then the concessionaires will have no responsibility in respect of insufficient supply of water, nor will they take any responsibility thereby by virtue of the terms of Art. 4, unless the Government will have sanctioned the taking of the required additional quantity."

So that it is in the hands of the Government to allow more if the one-fourth is not sufficient for the public need.

371. One-fourth of what?—One-fourth of the flow of the river—7½ million gallons per day.

372. And that is the maximum you can supply?—Oh, no, not the maximum I can supply.

373. Where do you get the rest?—In the same river in flood times, when I store the surplus at Krugersdorp.

374. Are you aware that water depreciates very considerably here by being stored in large quantities?—No, I am not aware of that.

375. It is so. And in consideration of carrying out this scheme you were to receive a guarantee from the Government of £20,000 a year?—Yes; that is under the old agreement.

376. Are you prepared to carry out the scheme without the assistance of the Government or without any agreement with the Government. If you can sell water at half-a-crown are you not prepared to carry out the scheme without the assistance of the Government?—The Government assistance enables me to sell at a lower rate than otherwise; but where the public need is so great I think a little aid from the Government is very proper.

377. And you have not endeavoured to do anything with the scheme without the aid of the Government?—No, I have not done so, because the aid of the Government was given before I attempted to form the company.

378. Is your scheme dependent on the assistance of the Government as intended in this agreement or in some modified form?—What do you mean?

379. Your proposed water scheme, is that dependent on the continuance of this agreement as it stands, or in a modified form?—Of course, in a modified form to meet the enlarged requirements.

380. It is dependent upon some agreement with the Government?—Oh, certainly. How can I do anything without the Government?

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381. I believe it appears in the report handed in that the water from Wonderfontein comes out from the dolomite formation?—Yes.

382. Is that the western or southern boundary of this formation?—I do not quite understand you. The dolomite formation runs a long way beyond Wonderfontein, if that's what you mean.

383. Which way?—It goes towards Potchefstroom and Klerksdorp.

384. And extends further along in this direction?—I believe it extends in this direction.

385. You heard the evidence of Mr. Willcocks in connection with the dolomite formation?—Yes.

386. And your own ideas and the knowledge of the country have led you to the same conclusions?—I hardly know what Mr. Willcocks' conclusions are.

387. Mr. Willcocks' statement was that this formation extended from Zuurbekom, in a westerly direction, all the way to Wonderfontein.—Did he say so? I don't remember him saying so.

388. I think if you refer to Mr. Willcocks' evidence you will find that he gave us the area of that dolomite formation.—I remember him saying that the springs at Wonderfontein must come out of a lower formation than Zuurbekom—a lower dolomite formamation, referring to the difference in height, 660 feet as against 1,050 feet. That I remember him saying; but not that it is the same formation. I don't think he said that.

389. At any rate you know that this formation extends right through the country there.—You can see by the map where it goes. I cannot tell you.

(*Mr. Thomson.*) I have no further questions, with the exception that after the adjournment I should like to ask the witness to obtain information for us as to the estimated cost of the scheme of 10 million gallons.

(*The Chairman.*) We should not press Mr. Goch closely on that point, because I am not sure that it is a fair question.

390. (*Witness.*) Exactly so. But I suppose Mr. Thomson's object is to get at the cost at which I delivered the water, as I have already answered him as to what I proposed to sell it at. In that case, for his satisfaction, I may state that it provides for the whole of the two millions capital, the interest on the capital, and the working costs; so that I think his question is really answered.

391. (*Mr. Thomson.*) I should like to know what the proposed expenditure on the works would be?—But surely you ought to ask your own engineer, who will instruct you on that point.

392. He is not the engineer for your scheme.—But you can submit that question to him. I have given the plans in, and he can estimate for himself what it should be.

(*The Chairman.*) I think if any question arises of adopting Mr. Goch's scheme, the Commission will go carefully into the cost.

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393. (*Mr. Thomson.*) There is no guarantee that the mines would take part in this ten million scheme, or would undertake to take the water.—I do not know. It purely depends upon the voluntary custom of the town and the mines.

394. (*Mr. B. Kitzinger.*) Mr. Goch, you mentioned in your evidence the intention to take water from the subterranean river?—Yes.

395. And you stated that it would be practically an inexhaustible additional supply. Can you give us any idea where that gets fed from, and whether drawing from that subterranean river would affect the supply of water from Wonderfontein Loop or from the dolomite basin which has been referred to in Mr. Willcocks's report?—It would not affect the fountains, because it is below the fountains.

396. It would not affect the loop?—No.

397. Nor would it affect the supply from the dolomite surveyed at Zuurbekom?—No. Zuurbekom is thirty or forty miles away.

398. You have no idea where it is fed from?—No.

399. You have no idea which other springs or rivers would be affected by drawing on that underground river?—No, I don't think there is anything likely to be affected by it; it seems isolated from everything. It cannot affect any supply.

400. So that is an addition that you regard as a very valuable asset?—Distinctly so.

401. You have been rather vague in your statement as to the new financial scheme. You have told us the capital would be £500,000, but you have not told us how much of that would be required for construction, how much for vendor's rights, and then with regard to the preferred shares you did not state as to what their position would be with regard to interest and capital.—The details of course would have to be fixed up with the persons who will undertake the responsibility of floating the company.

402. Quite so; but I take it you have some idea.—The preference shares will rank on the basis of 5 per cent., I understand, with probably some interest in the profits along with the ordinary shares. After the ordinary shares have been provided for there may be a share of profits for the preference shareholders, but that is not at all certain. It depends upon the terms on which these preference shares may be placed.

403. If this scheme should be adopted the preference shares would receive 5 per cent. before the ordinary shares are provided for, and after the ordinary shareholders receive a dividend the profits are divided?—It has not been settled. The annual interest on the debentures issued would be 3½ per cent.

404. Under the former scheme there was a guarantee of £20,000 for interest on debentures. You now state that £6,250 would be sufficient to meet interest charges on the further debentures for £250,000 which it is proposed to issue. How do you arrive at this figure?—Because I think the new conditions of a guarantee from the Government now in existence are better than the previous one, and would enable us to issue the debentures at a cheaper rate, viz., 3½ instead of 4 per cent.

405. Can you give me an idea as to the vendor's consideration under the new scheme?—No, I cannot give it to you, because that is a question between me and the parties with whom I am negotiating, but if the Commission decide in favour of a public scheme I am prepared to state what my terms will be.

406. On the assumption that a company is to be formed, I take it that a considerable portion of the £500,000 would be used for construction?—You will be astonished to hear what a very small quantity I will get out of it.

407. I take it then that out of the £500,000 a very small proportion would accrue to you in consideration of the rights acquired by you, and all the time and attention you have devoted to the matter for these many years?—Yes, I shall get a very small quantity out of the 500,000 shares.

408. Can you give us any idea?—No; I can give you no idea at the present moment.

409. So the Commission may take it you are very modest?—Indeed you may.

410. (*Mr. McCallum.*) You say, Mr. Goch, that you have got way-leaves all the way from Wonderfontein to the town?—Yes, to the proclaimed wards of the gold fields. Under the Gold Law the Government has the right of granting way-leaves on the gold fields.

411. Can you give us any idea of the yearly cost for way-leaves?—No, I cannot exactly at present, but that information can be furnished. There are no less than eleven contracts dealing with it, and I have no recollection of them all. Some are dear; some are cheap; some I bought outright; and some run on a yearly rent, but it is nothing extraordinary.

412. The shortest of them runs as long as the term of the Concession?—Yes, they are all running concurrently with the Concession.

413. You spoke of the water in these subterranean pools. Is it moving water?—Yes; there is a river flowing.

414. Can you give us any analysis of the water from the cave?—No, I have no analysis, but the presumption is that it is quite pure, because there is nothing there to contaminate it.

415. Have you the right, Mr. Goch, to lay pipes in the streets of Johannesburg?—Yes; in the "public streets," it says in the Concession.

416. Does that take in all private townships?—That is a question in dispute; I do not know. It will have to be gone into no doubt, but I do not propose to come into the town myself. I am going to deliver the water in a reservoir, so it is for the Town Council to deal with that question if they accept my proposal.

417. Then your capital expenditure would only mean delivering the water into the reservoir?—Yes.

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418. It does not include piping for instance? —No, but I can throw a little light on that. It is a question that may arise—as to what additional cost that will be to the town.

419. Can you tell us?—Yes. I estimate roughly £200,000 to provide for laying pipes in the town. That will allow them 100 miles of pipes anyhow. If the town raises that money at 3½ per cent. the interest would be £7,000 a-year. The collection of the water rates would be part of the machinery of the Town Council, and there would be no elaborate management required. I put down £5,000 as an ample provision for salaries in connection with the collection of the rates. That would provide a chief of department, six inspectors, and six sub-inspectors. Then to provide £3,200 for the amortisation of this loan brings us to £15,000 a year. That, on a consumption of five million gallons in the town means an expenditure of 2d. per 1000 gallons.

420. That is over and above the 2s. 6d.? —Yes; that makes 2s. 8d.

421. You spoke about the control or suggested a sort of control for the new scheme with two Government Commissioners and other directors. How would you elect the directors?—The directors of the Company do you mean?

422. Yes—It would be the usual way of course by the shareholders. The Commissioners would be appointed by the Government. Then there are the two Commissioners mentioned, who have control —inspection—of the books and every item of expenditure in connection with the concern.

423. What would the proposition of the control be as between the Directors and the Government Commissioners?—It is not a question of votes. The Government Commissioners hold a most important position on that Board, because they will be armed with all the powers the Government wish to arm them with under the Waterworks Clauses Act. It is not a question of voting, but a question of control exercised by the Government through these gentlemen.

424. (*Mr. W. St. John Carr.*) I understood you in the early part of your examination by the Chairman to say that the cost of water would increase *in ratio* as the consumption decreased?—Yes.

425. Afterwards you stated, discussing the difference between the ten millions and the five millions, that you will still charge the 2s. 6d. for the five millions?—Yes, if the Town Council will take that quantity, but if it takes less there must be an advance in price I anticipate.

426. What I understand you to mean is that you propose to charge for the water on a graduated scale which would increase in propertion to the reduction in the consumption?—It will increase if you take less.

427. I understand you to say you would take 2s. 6d. for ten million gallons, and for five million gallons you would also take 2s. 6d?—No. The presumption is that the balance would be supplied to the mines.

428. Do you consider that your contract is still current?—Why, certainly. Mr. G. H. Goch.

429. By what date have you to complete the work of bringing the water into Johannesburg?—By three years from the date the Government sanctions my final plans. November 25 1901.

430. Supposing they never sanction them? —They must do something. My contract is a contract.

431. Would your contract still remain in force?—If they do not sanction it? These are the conditions upon which the Concession is granted.

432. Then I understand from you, Mr. Goch, that so long as the Government withholds their consent to your plans so long will your contract for the supply of water from Wonderfontein to Johannesburg remain in force?—Yes.

433. And for the purposes of your contract you claim that the British Government is in the same position as the late South African Republic Government?—Yes.

434. A party to that contract; they take up the obligations of that contract?—I cannot conceive anything else. Surely the British Government would not do anything else. To the British a contract is a most sacred thing.

435. You speak with regard to the raising of capital, and say that you would require Government aid. To what extent do you propose to ask Government aid in raising this capital of two millions?—Only for £750,000

436. That is for the debentures?—Yes.

437. You ask for no guarantee for the preference shares?—No, only for the debentures. The Company provide a proper sum every year for the redemption of the debentures.

438. Then again I would like to ask you, as a man of great public experience, whether you consider it would be to the advantage of this town to have water supplied to them by a private company, which private company would derive all the profits, or whether it would be better for them to exploit the water business themselves and get all the benefit of the profits in a reduction of the water rate?—The thing is very complicated here. It has gone far beyond a municipal scheme. It is proposed to supply the mines as well as Johannesburg, and the towns along the Reef—Boksburg, Maraisburg, Florida, etc., all of these places, which are growing, have to be provided for. If you bring it down to the question of municipal supply then the question resolves itself to this: Is it better for those interested to go to a different source and get their own supply, or is it better for them to amalgamate and get it from one or two sources to be provided in that way? You will have the Municipal supply, so far as the municipal limits are concerned, by getting the water delivered in a wholesale way in the reservoir, yourselves dealing with it inside the town in whatever way you like. That is the municipal scheme. The mines will be in the same position;

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Mr. G. H. Goch. November 25 1901.

they will make provision for getting the water delivered to them in any way they choose. And, therefore, you will have no conflict between the two parties, and for that reason I think my scheme is far better than anything you can suggest.

439. You miss the point. You suggest that it would be better to have a general water supply to be controlled by a private board upon which there will be some Government Commissioners. Don't you think it would be in the interest of the public that the control should be vested in the community, and that all the profits should go for the benefit of the consumers of the water and not into the pockets of private shareholders?—You mean that the Government should carry it out as a departmental affair. I have no objection to that in the least.

440. Don't you think it would be better for the public?—I do not know. The management of a concern of that sort depends so much upon the men you appoint on the Board.

441. But supposing you have men who are capable?—Then it would be all right.

442. It would, then, be better to have it controlled by a public board?—I do not know that it would be better; it would be as good.

443. It would be cheaper as you would get all the profits?—The profits which are to be derived from such an undertaking are very small. It is only the difference between the low rate of interest you will have to pay when the whole concern is worked under Government management and the interest which will have to be paid to the shareholders on the comparatively small amount of ordinary shares.

444. That is all? It is not all, Mr. Goch. The difference is this that if the Government provided the money the town would have to pay 3½ per cent. interest on two millions in the manner in which you propose on the £750,000. You pay 4 per cent. on the debentures, you pay 5 per cent. on the preference shares, and on the ordinary shares you would pay 12 per cent. So you see that would make a very great difference in favour of the public?—No; for this reason, that they will have to provide two millions at 3½ per cent. plus redemption, which will make it more than our charges for interest and dividends. As fixed charges you will have not only to provide your 3½ per cent. but must redeem that loan, and if you want to redeem it in fifty years, say, the redemption on two millions would be in the neighbourhood of £38,000 a year. That will have to be added to your 3½ per cent. interest, which is a fixed charge on your concern.

445. But you see the difference? The 12 per cent. on your ordinary shares (I do not know what amount they are going to be fixed at) would amount to considerably more than £38,000 a year.—We have £750,000 of debentures on which we annually provide redemption, but we have £1,250,000 which remains without providing redemption. If you calculate the difference between that on a fixed basis and the redemption two millions at fifty years, you will find it very small.

446. But it is a free property at the end of fifty years. That makes a great difference?—Yes, it may be. If the objection is to having any profit on water supplied by a company, then you must make it a public work, and I am quite willing to treat with you on that basis if you like.

447. (*Mr. A. Brakhan.*) Do you claim the right not alone on the water which emanates from the fountain, but also to the water which goes along the Gemsbok Spruit?—Yes.

448. But the junction is a little below the spring. You have the right to both?—Yes.

449. Because I presume the junction is on the farm Wonderfontein?—Yes.

450. Then, again, you refer to a subterranean river in a cave. Which cave is that?—It is north of the stream. You will see it marked on the map.*

451. It is marked here "entrance to cave," is that the one?—Yes.

452. I understand you to say that that water runs from south to north?—It runs from where you meet it in the cave in a northerly direction.

453. Then the water disappears after it has passed the junction of Gemsbok Spruit. Coming from the fountain it runs along high ground, and on the north bank there are certain holes?—That is so.

454. Now, through these holes and crevices the water disappears?—Yes.

455. Now, is it not possible that seeing this cave lies to the west of the spruit that its water disappears through these holes and finds its way into that cave?—Oh, yes, I think so.

456. That would rather tend to show that it is not an independent supply?—Why?

457. Because it runs into it through the holes and flows to the north?—Who does it belong to? Is that what you mean?

458. No, I only wish to get at the quantity available, because if the water is taken away from where you mark the intake, and it does not run into the holes the supply in the cave will be affected?—I have to close up some of the holes in order to give those owners an equivalent amount to what I pump away from that intake Then whatever is over in the caves belongs to me.

459. But my point is this: Seeing that these holes and the cave are lower down than the fountain, and that the water disappears through these holes, possibly this water you find in the cave is really the water you would stop at the intake, and that by diverting this the subterranean river would be diminished?—No. That is one of the sources from which that subterranean supply comes—there is no doubt about it. It will be diminished when we close these holes, but independent of the holes there are supplies which come to it from other sources underground which

* See Appendix D. 4.

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will remain there. You can never stop the underground water by closing the holes on the surface or near the edge of the river.

460. But, of course, that is mere conjecture?—No, not conjecture. It is a fact.

461. Has any one been able to explore this cave?—I have been exploring it myself several times.

462. Now there is one point that rather struck me, and that is that you stated before, that the people who sold you certain rights sold you the right to a quarter of the whole, and that your agreement with the Government provides that no one else should be able to get the other three-quarters. It seems to me rather contradictory that those people should have the right of selling a quarter, and yet the Government could debar them from selling the other three-quarters. On what basis does that arise?—Your idea arises from putting the cart before the horse. The contract with the Government was not made by me, but by the owners. They made that agreement which carries with it the right to take one-quarter of the stream, and also the stipulation that no one else shall be given the right to take water away from that stream. They sold to me the whole of their rights as they stand. They are, therefore, debarred from dealing with anybody else for water from Wonderfontein.

463. You mean to construe that in this way, that by their entering into this contract with the Government allowing them to take away a quarter they did forego the right to the other three-quarters?—Yes, they did.

464. I take it that the claim is generally made that water rising on a farm is the property of the owner of the farm; and therefore those people have contracted away the right of taking the other three-quarters?—Exactly, as it stands in the Concession I took it from them.

465. And that is the construction you placed on the Concession?—Yes.

466. Now, I have read in one of the Blue Books—I do not remember whether it is stated by you or your expert—that there are certain difficulties in the way of any one else but the Waterworks Company laying pipes in some parts of Johannesburg?—Yes.

467. I mean not alone Johannesburg itself, but also the suburbs and private townships. Can you enlighten us how the matter really stands?—I am afraid you must ask the Waterworks Company. They set up claims to certain rights in the townships. They put up that claim I believe before the Concessions Commission, but in answer to a question the Chairman said they had failed in proving it.

468. You claim then that supposing the town entered into an agreement with you to supply water, that the Waterworks Company could not debar you from laying pipes in any part of Johannesburg or the suburbs.—Of course it depends upon what construction is placed upon the words "public streets" used in the Concession. If the Waterworks Company's contention is right that what they own are private streets, and that they could exclude either me or the Municipality from laying pipes there they will have to make that good. That is not a question that I can answer at this stage. Of course if I had to supply Johannesburg it is one of the questions I would immediately fight, because I would not consider that they had such a right myself. It would be monstrous to suppose that private owners could exclude the public from the rights to those streets—the right to bring to the residents water, gas, or electric light when they want it in their houses, and on that point the matter has to be fought. If I had the doing of it I would have to fight it.

469. Are you informed as to what is the position of consumers of water say in Doornfontein? Would they be able to avail themselves of your supply?—I believe Doornfontein is an exceptional position because it was the estate of the Waterworks Company formerly, and I believe they issued their licences with some conditions on them with reference to water supply, and I believe the residents would be bound by these conditions. That is not the case with Jeppestown or Fordsburg.

470. When speaking about taking away the water in the cave I understood you to say that some years ago there were tests made with corks and colouring matter. Do you think that the fact that the corks disappeared and did not come to light again would be proof that the water did not flow into the Mooi River?—I should say it is a very good sort of test.

471. Is there not a likelihood that the corks floating on the surface would be stopped in the cave?—Then there is no channel anywhere. The crux of the thing lies in whether there is a channel.

472. Of course they might be floating on the top, and the outflow being at a lower level they would remain in the cave?—Well, then there is no connection.

473. (*Mr. J. W. Quinn.*) Mr. Goch, would you please turn to the second part of the Concessions Commission Blue Book, page 236,—the statement put in by yourself before the Commission?—Yes.

474. The third paragraph states that "The Government, influenced by the fact that the Sanitary Board of Johannesburg had taken up the matter of a water supply for the town, withheld their sanction to the plans, and offered to the town authorities all the rights acquired by me in connection with this source of supply." Can you tell the Commission, Mr. Goch, please, upon what terms the Government offered the rights acquired by you to the town on that occasion?—What paragraph do you refer to?

475. Page 236, the third paragraph in the statement put in by you.—(Reading) "And I offered to the town." The printing is a little bit bad, but the word "I" is there.

476. Upon what terms did you offer that scheme to the town, roughly?—I tried to remember it this morning but could not. I think it was £84,000 plus some royalty on the water.

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477. I think it was somewhere in that neighbourhood, but what was the royalty?—That I cannot recall just now.

478. Following that statement to the next paragraph but one, you state there: "The Sanitary Board appointed a Committee to examine and report upon all the sources of supply, and after investigations which occupied nearly a year, this committee reported in favour of this source of supply as the most suitable." That refers to the Committee you mentioned this morning—the Committee of 1895?—No; the Committee I referred to this morning was the Volksraad Committee. This is the Sanitary Board Committee.

479. Then you say: "This (public) meeting, in spite of great disturbance and uproar, has on record the approval of the scheme." What meeting do you refer to there as having given its approval?—The meeting in the Circus.

480. Was there approval given to anything in that meeting?—Yes. You had better refer to the records of the Town Council. You will find it there.

481. I was present at the meeting. I thought the great thing there was to get out without broken bones. I do not think there was any resolution taken at all.—There was a resolution taken.

482. On page 241, you speak of the cost of the Concession. You make it roughly £20,000. Would you object to saying whether you have received any income to set against that?—Not a fraction; nothing. And the amount is very much larger than £20,000. I spoke in London without having my books present; but it is much more than that.

483. (*The Chairman.*) Just one or two questions. The remark you made about being willing to supply at 2s. 6d. a thousand, I suppose that is a new scheme which has occurred to you since we separated at luncheon. But it seems to me absolutely contradictory with the plan you proposed before, by which the prices are on a sliding scale based upon the interest earned by the Company?—No. You start with half-a-crown. If you find the Company make too much profit on that, of course the price would naturally be reduced.

484. Half-a-crown is not the minimum, it is the maximum?—I am prepared to supply at that price, which is the maximum.

485. Supposing you got enough consumption of water to bring the Company out all right?—Of course the price would depend on a fixed contract to take a certain quantity, and I suggested five millions, which does not seem to be an unreasonable amount to suggest.

486. Even so it seems to me an alternative proposal to the one you made before luncheon?—No. The half-a-crown would be the maximum provided I got a certain quantity contracted for. Then that would be subject to reduction if I made too much profit out of it. That is the only way in which the Waterworks Clauses Acts operate—if the Company makes too much profit the Government steps in.

487. Now, Mr. Goch, you said a few minutes ago, to my surprise, that you cannot conceive that the Concession was not binding on the present Government. Am I misrepresenting your remark?—No. It was made in reply to a question which suggested that the Government should cancel the Concession. It is a position I cannot conceive.

488. There is no question of cancelling a Concession if you do not recognise it. The Concession is either recognised or not recognised. If it is going to be recognised as a matter of course, I hardly see the necessity of your having appeared before the Concessions Commission in London, if you take the position that the present Government is bound by the obligations of the late Government?—I do not take that position. I only put it on the basis of what is just or fair. I am in the hands of the British Government, and as a subject I must bow to whatever decision they may come to, whether I regard it as just or not. I base my sole rights on the sense of justice of the British Government, and I feel that there is no better foundation for any man to stand on.

489. If you recollect, the Chairman of the Concessions Commission went so far as to warn you that the Parliament at Home occasionally interferes with concessions in a manner that Parliament itself thinks right and the concessionaires think wrong?—Yes, but recollect what that arose from. He suggested that I should subject my scheme to the control of the Waterworks Clauses Acts.

490. Hardly a suggestion, and I think he went on to remark that Mr. Goch is in the hands of the Government, and the Government are not in the hands of Mr. Goch?—That is so.

491. But where there is a question of public policy concerned, and where it might be considered contrary to public policy that water supply, on which the life of the Rand depends, should be in the hands of a private company, it is quite conceivable, however you regard it. that your concession might be transferred to a public body. I can conceive such a thing, and I do not think this Commission would like anything to go forth from them implying that you have a concession which is binding on the present Government, seeing that by the terms of the reference to them the control of the water supply of the Rand by a private company appears to be more or less excluded, and that in any case it is the duty of the Commission to find the cheapest, most reasonable, and most workable scheme they can to supply the needs of the Rand without particular reference to the position of any person who may have interests in supplying a portion of the district with water?—I quite agree with you, provided I am not to be plundered for the public

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benefit. I say it with all respect. It would involve that if I am deprived of my rights for the sake of giving water, say ½d. per 1,000 gallons cheaper to the public. That I cannot conceive. I am quite willing to come to any reasonable terms provided the Government decides that the water supply is to be a departmental affair—public works—and I am prepared at any moment to treat with them.

492. Perhaps you will agree with me after luncheon, as you agreed with me before luncheon, that whatever the position of the Government, even if they say, "You may take the water to Johannesburg," you cannot make the people of Johannesburg take the water?—That is quite right.

493. And if your terms were too onerous it would be open to Johannesburg to go to other sources?—Yes, I am in that position, I can quite understand.

494. The last question of all. You used the word plunder. You may mean by this either leaving you out of pocket and without recompense for the money and the undoubted labour and brain work which you have expended on the scheme, or else the prospective profits which are locked up in your breast, and the results which you would not derive if your scheme is not adopted in its entirety. I don't think that on this occasion we will ask you to answer which is your meaning?—I am quite willing to treat with you for one. Once you say it is to be a public scheme I will tell you what I want, and we can come to an arrangement. At the present time I am in touch with financiers, who are willing to carry out the scheme, and I cannot disclose what they are willing to give.'

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495. What I want to point out for your protection and for the protection of the Commission is that the Commission is free to deal with this scheme, to ignore it; or to do anything it pleases. And that position, I think, you understand?—Do you claim that position—that you can ignore me?

496. Absolutely.—Well, it is as well to know where we are.

497. Will you be prepared to go on with your evidence the first thing next Monday?—Yes, certainly. What is there? The one special question?

498. (*Mr. Lance.*) What I want is to go through with the Town Engineer, the reports and plans put in, and see if any questions arise.

(*The Chairman.*) Yes.

(*Mr. Hull.*) Will you take Mr. Sykes now? He is quite a short witness.

(*The Chairman.*) Will half-an-hour do?

(*Mr. Hull.*) Less.

(*The Chairman.*) Yes, we can take him.

(*Mr. Raubenheimer.*) I represent some of the lower riparian owners on Wonderfontein. May I please ask Mr. Goch a few questions at the next or adjourned meeting?

(*The Chairman.*) No formal application has reached the Secretary for permission for any one to represent riparian owners. If application is made it will be considered by the Commission.

(*Mr. Raubenheimer.*) Must I make the application in writing?

(*The Chairman.*) Certainly. If you make an application before the next meeting you will receive an answer.

Mr. Samuel Sykes, called and examined:

Mr. S. Sykes. November 25 1901.

499. (*Mr. Hull.*) What are you?—An engineer.

500. You have had considerable experience during the last twenty years of taking measurements of running water?—For the last sixteen years or so I have been more or less engaged on this class of work in this country and in Australia, New Zealand, and India.

501. In 1897 you represented some London friends of yours here?—I was asked by them to go out and measure the water at Wonderfontein with the idea of ascertaining the absolute minimum supply that it was possible to procure from there, as they contemplated the possibility of investing money in the scheme.

502. Mr. Goch handed in extracts from letters which you wrote to your friends in London. Those extracts were written at the time and are correct?—They are correct. They were written as private letters.

503. They contain a true reflex of the opinions formed by you at the time as to the quantity of water?—Absolutely.

The Commission then adjourned.

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WITWATERSRAND WATER SUPPLY COMMISSION.

MINUTES OF EVIDENCE.

THIRD SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

MONDAY, 16TH DECEMBER, 1901.

Present:

G. V. FIDDES, Esq., C.B., Secretary to the Transvaal Administration (Chairman).

A. BRAKHAN, Esq.,
B. KITZINGER, Esq.,
G. ROULIOT, Esq.,
W. McCALLUM, Esq.,
J. W. QUINN, Esq.,
W. St. JOHN CARR, Esq.,

G. CRAIG SELLAR, Esq., Secretary.

WONDERFONTEIN WATER SUPPLY (*Continued*).

Mr. George Henry Goch, called and further examined:

Mr. G. H. Goch. December 16, 1901.

(*Mr. F. C. Dumat.*) Before proceeding with the questions which Mr. Lance proposes to put to Mr. Goch, there are one or two questions arising out of the evidence of Mr. Goch given at the last sitting which he would like to have an opportunity of offering a few remarks upon, and so as to facilitate the matter these points have been reduced to a draft which Mr. Goch would ask leave to read, or to be allowed to be read and handed into the Commission as supplementing points arising out of his evidence at the last sitting.

(*The Chairman.*) Do I understand they are likely to answer some of the questions Mr. Lance proposes to put?

(*Mr Dumat.*) Oh, no.

(*The Chairman.*) If not, I would like Mr. Lance to put his questions first, and then I have one or two questions to put to Mr. Goch. If it is equally convenient to you we will take Mr. Goch's statement afterwards.

(*Mr. Dumat.*) Mr Goch's statement and your questions would come together.

(*The Chairman.*) Very well.

504. (*Mr. Lance*, representing Town Council, Johannesburg.) I will deal first, Mr. Goch, with a little question of figures which arises out of a question put to you by Mr. St. John Carr. You were then dealing with the relative expense of a scheme worked by a local board, and in Question 444 I think you refer to the fixed charges for redemption to the sinking fund which would be required by a local board, as amounting to £38,000. I have had drawn up a statement which I will hand in to the Commission through you. It has been prepared by the Statistician to the Town Council, and I will read it.

"Mr. Goch, in reply to Question 335 says: 'I make provision for a capital of two millions in all.' Also in reply to Question 444 he says, 'No, for this reason, that they will have to provide two millions at 3½ per cent. plus redemption, which will make it more than our charges for interest and dividends. As fixed charges you will have not only to provide your 3½ per cent., but you must redeem that loan, and if you want to redeem it in fifty years say, the redemption on two millions would be in the neighbourhood of £38,000 a year.' Allowing for interest on £750,000 debentures at 4 per cent. plus sinking fund to repay £750,000 in fifty years by cumulative annuity at 3 per cent. compound interest and also for interest at only 5 per cent. on the remainder of the capital (£1,250,000), the annual charge under Mr. Goch's scheme would be:

Interest on £750,000 at 4 per cent.	£30,000
Sinking Fund, do., at 3 per cent. (50 years)	6,650
Interest on £1,250,000 at 5 per cent....	62,500
Total	£99,150

A public body raising £2,000,000 at 3½ per cent. and providing a sinking fund to repay this amount in 50 years by cumulative annuity at 3 per cent. compound interest, would have the following charges:

Interest on £2,000,000 at 3½ per cent.	£70,000
Sinking Fund, do., at 3 per cent. (50 years)	17,732
Total	£87,732

Saving in annual capital charges £11,418, and undertaking the property of ratepayers after 50 years." Will you look at this statement, Mr. Goch, and say whether it corrects the figures you gave?—In reply to Mr. St. John Carr, of course I gave an off-

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hand answer. I had no time to calculate in any shape or form, and I stated that the fixed charges of the municipal scheme would be more than mine, because the redemption of the two millions would have to be fixed, whereas the redemption of only £750,000 would have to be fixed in my case; and I roughly estimate that if the redemption proceeded on the basis of 2 per cent. per annum less the interest the amounts year after year put aside would bring, it would roughly come to £38,000. There is, however, another way of reckoning it. You either proceed with the maximum amount of redemption on the first year and keep it at a fixed amount all through the period, and calculate the redemption of your capital and the saving of interest as against that, reducing it at the end of 50 years to vanishing point. Or you proceed in another way —you average the maximum with the minimum at the end of the period and strike an average somewhat on the basis of the Local Government Act in England. When you have a fixed rate of annual charge to redeem at a certain amount, the fixed rate redeems the amount in the period over which you have extended the loan. In that case the figures would be different to what I suggested, and the figures you give here would be approximately correct. £87,732 would, therefore, on that basis be the annual fixed charge for your scheme. I see you have reckoned my scheme on the basis of 4 per cent. interest. Of course I stated that I thought a loan could be raised for 3½ per cent. interest with a Government guarantee. Therefore, in calculating this you should take the same rate of interest that you take yourselves, and accepting your figures therefore as correct, with this difference, you will find that £7,668 per annum instead of the £11,418, as you here put it, is the saving. Now the difference is not, of course, very great. I have also qualified my statement in reply to Mr. St. John Carr in this way. When he asked me whether it would not be better to have it as a public municipal scheme, I replied that I did not think it would be better, it might be as good. I wish to say again—and I think I emphasised it at the time—that under the management I proposed, a Board of Directors personally interested in the undertaking instead of honorary members of a public board, I would probably effect a further saving as compared with what a public board would do, and on these lines I think I was fairly right in saying I did not think a municipal scheme would be a better scheme but it might be as good. I do not of course wish to acknowledge any discussion of these figures just now in trying to disprove that it may be more advantageous to the public having a public scheme, but what I wish to emphasise is that the difference would be very small, and that with our working we might probably neutralise the apparent difference.

505. The difference which you suggest on the figures—the reduction of the interest to 3½ per cent.—is dependent on a Government guarantee?"—Yes.

506. And there is this difference, that in our suggestion of a public body the undertaking would be the property of the public at the end of the period?—Yes, but you will have to provide for depreciation, to provide a fund to renew your plant at the end of that period. You cannot renew it for nothing.

507. We shall probably have something substantial. Now, Mr. Goch, you refer to the management of different waterworks under the Waterworks Clauses Acts in England, and suggested that as a possible basis here. Do you know anything of the working of these Acts in England?—Do you mean by practical experience?

508. Have you studied the question at all?—Yes, I have read the laws, and I have discussed the matter with a very eminent man connected with waterworks in England.

509. Is it not the experience that it is the tendency of these waterworks companies to run to extravagant management? As it is necessary to keep dividends down, isn't there a tendency to pay higher salaries and go in for more extravagant management generally?—I do not think so.

510. Now we come to the technical points. I may say, Mr. Chairman, that at Mr. Goch's request the questions on these technical points have already been handed to him. Mr. Goch, in your scheme we do not find any mention of the size of pipe; you give us no information on that?—You mean for the ten million scheme?

511. For the ten million or for the three million scheme. We do not find any given at all?—For the three million scheme it was intended to have pipes ranging from 16 to 18 inches. The pipes for the ten million scheme would range from 28 to 32 inches.

512. And you proposed one main only?—One main.

513. Now, in your ten million scheme, a very important feature is the storage reservoir, which you propose to construct near Krugersdorp, and you say, I think, that it should be a reservoir containing 300,000 million gallons. Have you arranged for a site for that?—Yes; you will find it in the *correspondence, which I have handed in to the Secretary, between the late Government and myself or Messrs. Haarhoff and Hull, as the firm was at that time, in which application was made for the ground at Krugersdorp. The correspondence between the Government and myself relating to that and the reservoir at Johannesburg, as well as other matters, you will find it in the correspondence between the dates of 28th February, 1893, and 6th October, 1893.

514. In that correspondence do you ask for Government ground?—Yes; and we filed plans showing the reservoirs we required, and they are all in the Government Offices at Pretoria.

515. These plans are not before the Commission?—No, but they already form part of the documents, but when I applied at Pretoria for leave to get them, a year ago, they could not be found. Possibly they may be obtainable now.

* Not printed.

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516. Confining ourselves to the Krugersdorp reservoir; what style of reservoir do you propose; is it to be a built reservoir or a dam in a kloof?—That is purely a matter for the engineer of the works to settle. I cannot, of course, answer technical points of that sort, but the conformation of the ground is favourable for the construction of a reservoir partly built in the shape of a dam and partly excavated out of the hill.

517. In either case, that would require a very large area, wouldn't it?—Not necessarily.

518. Have you worked out the area that would be required under either plan?—You suggest in the notes you handed to me 10,000 feet long by 500 feet wide. You present therein a surface of something like five million square feet, but that, in view of the evaporation, would be a very wasteful way of proceeding. And the reservoir which would suit our purposes in every way would be one more on these lines: 2,500 feet long by 1,000 feet wide, and 20 feet in depth. This will give you a surface area of 2,500,000 feet, half of yours.

519. Yes; but wouldn't excavating a reservoir to that depth mean an enormous expense?—No. It is far better to face a capital expenditure which will afterwards effect an enormous saving of water than to proceed in a slipshod manner and construct a reservoir which will waste so much water.

520. On what basis do you accept the evaporation in this country?—Your suggestion is that it would be 180 million gallons per annum. I have no reason to dispute that it may be quite that, and if you take that basis you will find that the evaporation will be 90 millions under my scheme instead of what you suggest.

521. We suggest a reservoir to average 10 feet, and you suggest a reservoir 20 feet deep, and you consider that from an engineering point of view that is practicable?—Certainly.

522. So that you would reduce your evaporation to 90 million gallons, which would give the 90 million gallons referred to by Mr. Hunter, whilst the area would double the evaporation?—Certainly.

523. Now about filter beds. You do not show any filter beds; you simply show the space for filter beds, but you give no details. Have you secured the area of these?—Here at Braamfontein?

524. Yes.—Yes. There is an area shown on the plans, and before we decided on that spot for the reservoir and the filter beds, which were at that time contemplated, the then Mining Commissioner went there with the engineer and pointed out the ground that could be got, and on that basis it was surveyed and put in on the plan.

525. What area do you propose for these?—An acre and a quarter was allowed there, I think.

526. Do you know the space required for filter beds in London, that it requires three square yards for every 1,000 gallons?—No, I am not aware of it. That may be quite right, but I wish to point out to you that filtering the Thames water in London is a totally different thing to dealing with water that is pure, and that, if it requires filtration at all, would not require such an area for filter beds.

527. But we are correct in saying, are we not, that taking the London basis—three square yards for every thousand gallons supplied—the area required for your scheme would be 30,000 square yards?—No, I do not admit that for a moment, and I do not admit that you are right in stating it in this way, having no knowledge of the subject myself. But you cannot require the same space for the filtration of the Wonderfontein water as you would for the Thames water, if filtration is required at all.

528. Now, what capacity of service pipe do you propose?—The scheme for three million gallons worked out at 6 inches for every million capacity. We should probably have to double or treble the total for the ten million scheme. But these are surely matters where the engineers will do whatever is necessary should be done.

529. But you name an approximate capital, and these plans concern that. Now in dealing with the quantity of water that you can deliver, Mr. Goch, the ten millions, I do not see any allowance for leakage of pipes?—Yes, engineers usually allow for that, and when they state a certain amount daily they give you the net amount.

530. Do you know what has been allowed in your scheme for leakage, because it means so much more taken from the springs than the net amount delivered?—I know that in Mr. Hunter's calculation for the three millions he allowed something like 12 per cent. for wastage.

531. So that in reckoning the ten millions you must provide for a larger amount from the springs?—Yes, you must provide a certain amount of leakage.

532. Now, in arriving at the quantity of water available for your ten million scheme, you rely, or apparently Mr. Hunter relies,* on the statement of Mr. Aburrow, that a maximum supply of 54 million gallons can be taken in rainy weather?—That was Mr. Aburrow's measurements at a certain date.

533. Can you give us some data for that? You have not put in Mr. Aburrow's report? We have simply the statement in Mr. Hunter's report that Mr. Aburrow said so. You have not put in Mr. Aburrow's report?—No, I have accepted that as correct.

534. Mr. Aburrow is in town is he not?—I do not know.

535. Mr. Hunter's scheme is based on this maximum of 61 millions worked out on certain average quantities of water to be obtained during certain seasons of the year. Do you know what data he went on in regard to that?—No. It was the maximum and the minimum, and he split the difference, gradually increasing or decreasing the amount of water according to the season.

536. Then it simply comes to this, Mr. Hunter got the maximum and the minimum, so that his calculation in between is simply a matter of conjecture?—The question of the supply could be carefully gone into if

* See Appendix D. 6.

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you built a weir and left it standing for a whole year; but we have not advanced to that stage yet, but we have given you a margin for all contingencies. You will find there is a margin of 300 million gallons roughly speaking. Five hundred million gallons is the excess during the wet season, and roughly 200 millions is the deficiency during the dry season; you have therefore a margin of 200 million gallons.

537. Yes, but I do not see any data for arriving at this maximum or the average. Surely, that is a point of such vital importance that it ought to be gone into and evidence heard on the subject?—From your own knowledge of these streams do you consider the maximum or the minimum very wrong?

538. It is not a question of my knowledge. Has Mr. Hunter been in South Africa at all?—No.

539. He is a Westminster engineer?—Yes.

540. So that he has not had any personal experience of South Africa?—No.

541. Then it seems to me that he has conjectured these figures. Now, Mr. Goch, on this question of the quantity of water. Did you go with the Commission to Wonderfontein a few days ago?—Yes.

542. Was the quantity then running a minimum or above the minimum?—Well, we could only judge by what we saw. There were no measurements taken. But I was advised by Mr. Sykes that the supply seemed to him to be unaffected, and that his estimate at the last visit corresponded with his earlier measurements approximately.

543. That the amount running then was the same as when he took his measurements?—Approximately.

544. There has been a good deal of rain lately—during the last couple of months?—There has. We have had rain in November.

545. Now, if that volume of water were increased at any time to 54 million gallons, as Mr. Aburrow suggests, it would involve a considerable increase in the depth?—I could not say, because it is a very broad stream. It adds to the width I believe.

546. I believe the average depth at present is two feet; the plans show it?—Yes, the plans show it.

547. So that if you increase the 30,000,000 which you say was the flow to 54,000,000—you would have double the quantity of water. Would not that involve a rise of nearly a foot?—It might.

548. Now did you notice the other day when you were at Wonderfontein a little foot-bridge. It is I believe close down on the water?—I did not pay particular attention. It is not very far off certainly.

549. Is not it a fact that when you cross the bridge you almost go into the water?—No.

550. Is it not just clear of the water?—No, I think there is plenty of depth.

551. That is the foot-bridge that was there before the war?—Mr. Sykes did not recognise it. He was not quite sure of its locality. It might have been moved possibly.

552. You could not of your own knowledge say?—No. I saw it when I was there with Mr. Willcocks, but not before the war.

553. My information is that it is the same as before the war; and it has not been washed away?—It may be.

554. The intake in your plans is below the junction of the spring and the loop?—Yes.

555. And the water coming down the loop would be affected by surface drainage, would it not?—It would, certainly.

556. So that that water would require a good deal of filtration?—But we are not going to take the water there as we told you before. The intake on the plans is a theoretical intake, and we need not take it from dirty water when we have plenty of pure. By putting the suction pipes a few yards up you get clean water; we take the water from a clean spot instead of a dirty one.

557. On the plans it is shown at a particular point which involves dirty water coming in, but you say that you propose to take it from the spring alone; so that you propose putting your intake somewhere else?—No, it is practically at the same spot. The mark on the plan is to show where the measurements were taken.

558. And there are no engineering difficulties as regards putting the intake further up?—No, none.

559. Now you say the 10,000,000 gallons per day is only intended to be part of the total supply required?—That is what I propose to deal with within the limits of my rights.

560. You don't imagine that is going to be enough for the mines and the town?—I have no information before me what the mines and the town want. If one had that evidence one could answer you.

(*Mr. Lance.*) That is all I would ask the witness.

(*Mr. Dumat.*) Is it the practice to allow barristers to put a few questions on the points raised? For instance, on this question of the measurement of the water by Mr. Aburrow and Mr. Sykes. What I would like to point out to the Commission is this: That Mr. Sykes' measurements took place at the dry time of the year, and Mr. Aburrow's took place in March.

(*The Chairman.*) If you want to bring it out from Mr. Goch I have no objection.

561. (*Mr. Dumat.*) Have you any knowledge when Mr. Aburrow's gauging took place?—I understand it was in February or March.

562. At the end of the rainy season?—Yes.

563. And at the time when our local rivers flow at the highest?—Yes.

564. Do you think that the rain we have had this season could as yet have in any way affected the flow of the stream at Wonderfontein?—Hardly, because flood waters, when they get into the loop, will flow away, but to strengthen the springs will take a matter of time; and the rainy season has to advance a good deal before the strengthening of the springs in the dolomite takes place.

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565. Although Mr. Hunter's estimates on the flow in the stream for the different months of the year are not based on actual measurements during those months, they are yet based on very reliable data—the measurements at the lowest and at the highest periods of the year, and therefore they appear to be reasonable deductions from those two measurements?—Yes, and if the point Mr. Lance wants to make against me apparently is that I cannot get the ten millions on account of the data given not being quite reliable, I may point out that the spring as we find it there is choked up with reeds and growths of all kinds. If we were to clear away these we would probably get double the flow from that spring. I quote to you in support of this the actual experience on the Lesbeck River in Cape Colony where the flow originally being 500,000 gallons a day, by opening up the springs, increased to 1,200,000 gallons a day, and the same possibly would occur here—that you would greatly increase the flow of that spring by clearing out the overgrowth of reeds and other matter.

(*Mr. Dumat.*) Shall I put in Mr. Goch's statement now?

566. (*The Chairman.*) Yes. I take it, Mr. Goch, this is your statement?—Yes.

(*Statement read.*)

SUPPLEMENTARY STATEMENT MADE BY MR. GOCH.

After perusal of the proofs of evidence given by me on the 25th November last, I desire to offer to the Commission the following supplementary remarks:—

Referring to questions and answers 488 to 496 of my evidence, I would refer the Commission to

> The Report of the Transvaal Concessions Commission, dated 19th April, 1901, Part II., Minutes of Evidence, page 241, Questions 4068 to 4073,

and to

> That Commission's Report on the Wonderfontein Water Supply, page 130, Paragraphs 15 and 16.
>
> Par. 15. We are of opinion that this Concession was lawfully obtained, and that its conditions have been fulfilled, except in so far as has been prevented by the war, and the delay of the Transvaal Government in returning the plans.
>
> The contemplated Water Supply appears to be of an excellent character, and it would, under proper control, be made an important public benefit.
>
> CONCLUSIONS.
>
> Par. 16. The Concessionaire intimated to us his willingness to enter into negotiations with the British authorities for the regulation of his enterprise, on some such basis as that which we have already recommended, and we advise that his Concession be recognised subject to that condition.

Referring to Questions 261 to 292, and in particular to the question put by the Chairman of this Commission, Question 290, I should like to re-establish, and in accordance with the desire of the Chairman expressed in Question 261, to check any false conclusions which may have been come to.

I set out hereunder a statement of the financial part of the scheme as referred to by the Chairman in Question 261:—

	£	s.	d.
Estimates of income on 3,000,000 gallons per day at 3s. 3d. per 1,000 leaving about 12 per cent. for wastage	160,710	0	0
ESTIMATE OF EXPENDITURE.			
Mr. Hunter's estimate of expenditure, including sinking fund, as required by terms of Concession...	63,576	0	0
To which add:			
Interest on £500,000 debentures at 4 per cent. ...	20,000	0	0
Redemption of debentures ..	10,000	0	0
	£93,576	0	0
12 per cent. interest on capital	60,000	0	0
Surplus to Government, ¼ ...	1,783	10	0
Surplus to Company, ¾ ...	5,350	10	0
	£160,710	0	0

If, in competition with existing Company, we had to sell at 2s. 6d. per 1,000 gallons instead of 3s. 6d., the profit on share capital would only be 8 per cent. instead of 12 per cent.

The above figures constitute a reasonable financial statement worthy of more attention than the series of suppositions made in Questions 261 to 292, for they are based on Mr. Hunter's evidence (Questions 4146 to 4147, Part II., Minutes of Evidence, Transvaal Concessions Commission). Mr. Hunter distinctly excluded in his estimate the costs of redemption of debentures and sinking fund, which I have established in my statement. On the other hand, Mr. Hunter estimated a gross income of £160,000, and not £274,000, as the Chairman of this Commission suggested, Question 285. The inference therefore come to by the Chairman of this Commission to the effect that "the Government by allowing me to take the water from Wonderfontein to Johannesburg would be fleecing Johannesburg of £30,000 a year," is not supported by reliable figures. Neither

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would £89,000 have gone into the pockets of the shareholders. On the contrary, my scheme must be credited with the capacity of relieving Johannesburg of about two-thirds of the burden the population is bearing, with the further contingency of increasing such relief to three-fourths of that burden by reducing the price to 2s. 6d. or to even less than that in the course of competition.

(*The Chairman.*) Does that conclude your evidence?

(*Mr. Dumat.*) Yes.

567. (*The Chairman.*) Mr. Goch, the statement that has just been read for you resolves itself into this: that by putting down the price of water sufficiently you can make the profits disappear. It is a pure hypothesis that if your scheme were in operation you would sell at 3s. 3d., and another hypothesis that you would sell at 2s. 6d., and it is equally an hypothesis that you would sell at 10s.?—I think these figures are based on the condition of things as they are, on no hypothesis. We are in competition with an existing Company, and therefore cannot hope to get more than these figures.

568. I confess I do not follow you. You both have the right to charge 10s. It is possible that the demand for water would be so great that you would both want the 10s. It seems to me conclusive that as a Company you would not sell at a loss?—If I had a monopoly probably I would not.

569. But even if you were in competition, I do not think the one Company would wish to cut the throat of the other?—I do not know that. Where there is competition in trade the public is quite safe.

570. The only difference between us is that my figures are based on an hypothesis of 5s., and your figures are based on an hypothesis that you might sell at 3s. 3d. or 2s. 6d.?—Yes, and mine is the more reasonable one, bearing the condition of things in mind.

571. I am content to leave it at that. Without going over again what we were discussing last time, I want to be quite clear about the position you assume with regard to the Executive Council resolution of March, 1898. I think I am right in saying that you claim that the resolution in effect said that from whatsoever time the Government gave its final approval to your final plans they had given you three years to complete the work in. Is that a correct statement of your intention?—The effect of the resolution cannot be otherwise, the Volksraad having before them the letter of the Government to me in March of that year. The resolution therefore can only have reference to the explanation given in that letter.

572. I correctly state your view, is that so?—I take the resolution of the Volksraad to mean that no further extension shall be given beyond that of March, 1898.

573. Not the Volksraad; we are discussing now the Executive Council resolution, or the letter rather, of March, 1898. It is on page 297 of the documents of the Concession Committee, D 11. That, I believe, is what you base your contention on?—Yes, I see the letter. It is a letter from Dr. Leyds to Rooth and Wessels.

574. That is the only letter I think you had from the Government with regard to the extension of time?—That is the last letter, yes.

575. And that is the one on which you rely for your contention that the Government gave you an increase of time; and I ask you if your contention is that by that letter the Government gave you three years for the construction of your works from the final approval of your plans, whenever their final approval might be given. That, I understood to be your contention, and I want to make sure what it is?—The letter in itself does not carry all that you say, but the circumstances surrounding it and the facts of the case bear out that position.

576. That is your position?—That is my position.

577. That is what the Government gave you in the way of extension?—What the Government gave me is in this letter, what the conditions of my contract give me is there.

578. And you construe that to mean that whenever the Government have finally approved of your plans, which they never did, you would have three years from that time to construct your works?—Yes.

579. I am stating your position correctly?—Yes, that is the position.

580. Now, have you read the debates in the Volksraad of the 12th July, 1898, when the Volksraad passed the resolution which is set out in these papers?—No, I do not think I have read the debate, but it arose from a report.

581. I have read the debate.—The debate arose out of a report of the Inspector of Offices, and the Inspector stated the facts wrongly before the Volksraad.

582. That, of course, is a matter we must differ on, but what I wanted to suggest is this, that the Inspector reports that the Government gave you to January, 1899, to finish your works, and had extended that period for one year.—He was quite wrong in stating it that way.

583. Now, I put it to you, that in that debate there is not a word from beginning to end to show that, anybody else took a different view of the effect of this letter of Dr. Leyds.—That may or may not be, but we surely regard the actions of the Volksraad not by the debates but by the resolutions.

584. Yes, but we can interpret a resolution if there is any doubt by what the members had to say on the subject.—And the resolution of the Volksraad does not in any way clash with this letter.

585. No, but I confess it is inconceivable to me that you can put any construction on the letter other than its plain statement that the Government gave you one year more from January, 1899.—If that is so we must agree to differ. I beg to point out to you that the Executive Council was acting under a power of attorney from the Volks-

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Mr. G. H. Goch. December 16, 1901.

raad authorising them to make a contract with me, and that this letter has the full weight of the Volksraad arising from that resolution. Consequently, if the Volksraad in a subsequent resolution desired to cancel the decision or the powers of the Executive Council they should have done so in a more direct and explicit way if it was intended to support your view of the case. In the absence of that, and reading the resolution of the Volksraad, I say that on the face of it it refers only to this letter regarding the extension of time, and it does not clash with my view of the case.

586. It seems to me that your position is this: that when you ask for one thing and the Government gives you another, you take it that the Government gives you what you ask for. You ask that the two years stipulated for in the concession should be taken from the date of the approval of the new plans. That was on January, 14th. In reply to that they did not take the faintest notice of your suggestion that it should be taken from the date of the approval of the new plans, but inform you: "In reply to your letters of 14th January and 8th February last, having reference to the Wonderfontein Waterworks Concession for Johannesburg, I have the honour to inform you that the Executive Council have decided to extend by one year the period within which, according to Clause 9," etc.—May I ask you, please, which letter you quote from?

587. I quote from yours of the 14th January.—Of course it is a very different thing in an enquiry of this sort if only an extract is given from a letter. The whole sense of the letter is not conveyed by giving extracts only. In this letter you will find that we clearly laid the case before the Government, and pointed out to them how the matter of the final approval of the plans would operate, and in order to induce them to come to a settlement, we suggested as an alternative that if they brushed aside the first suggestion that we emphasised so much, they should proceed on the other lines, and in any case give us this extension of the 26th March.

588. I do not think that can have been the view of the Executive Council, because Mr. Schalk Burger was present at this debate, and I find nothing in his remarks to show that he took that view. He seems to have taken the view of the Inspector.—He may have been in opposition to the Executive Council.

589. When you saw this statement of the Inspector of Offices, and that the Raad adopted a resolution accepting for notice that report, which I take to mean is the technical way of expressing approval of the report, did you take any steps to protest against the views expressed in the report and by the members of the Raad, or to put the thing on a right footing and make it clear what your position was?—I was not in the country at this time.

590. But your representative was.—I saw the Inspector afterwards, and he admitted he was wrong, and said he would appear before the Volksraad and would explain the matter. I left the country, and thought the matter would be attended to, but it appears the report was dealt with without any explanation from the Inspector.

591. There is another point. We must not be unfair to the Johannesburg Waterworks Company. I think it was stated in your evidence the first day that the delay in the acceptance of the plans was really due to the antagonism of the Waterworks Company, and I notice in the statement that you put in to the Concessions Commission, you say the Government wrote on January 22nd, 1897, approving of the plans that had been filed four years before. You recollect the quotation which is on page 237 of part 2 of the Concessions Commission's report?—Yes, it is there I have no doubt.

592. From that I infer that you were referring to your plans of 1893?—That is so.

593. But I have had an opportunity of seeing some of your correspondence with the Government, and amongst other documents, I notice a letter of the 25th November, 1896, in which you say in effect: "My engineers are busy with the final tracings . . . . and I hope to put in my plans within a fortnight." How can you explain the difference between these two statements?—That was in 1896.

594. November, 1896. You say: "I then shall be ready to give my orders," and so on?—I was in Europe at the time, and it was after the contract with the Government of October 6th, in which they guaranteed the £20,000 per annum. With their cognisance we were proceeding to form a company in Paris at that time, and the Parisian people had sent out their engineer here to go over the plans once more, and with the consent of the Government authorities, he proceeded to make new plans to carry out the scheme in a way in which the Government desired, and the letter which has been read must have had reference to the work of this man who was here at that time.

595. So that really the final plans were not ready until the beginning of 1897 or the end of 1896, or did you put in any plans?—The plans had been in all the time from 1893. The French people desired to make an alteration, and we re-surveyed the ground, and were making new plans according to their ideas as to how the work should be carried out. The plans we refer to in that letter of November had reference to this work that was then proceeding.

596. Still it is clear that these alterations, proceeding as they were from the side of yourself and your friends, involved delay, and that this was necessitated, not by the action of the Government, but was caused by the requirements of your financial friends in Europe?—Yes, supposing it was so, what is the inference you wish to draw from it?

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597. Only that there was this delay on your own part, while you say you were eager to get the plans approved and the work begun?—I do not quite understand you.

598. According to this statement the plans lay for four years in the Government Buildings awaiting approval, whereas I now understand you were not really ready with your plans in such a shape that you could get your company floated before the end of 1896?—Do you wish to controvert the statement I made here about the Government having withheld their sanction of the original plans owing to the Sanitary Board having taken up the matter? I do not quite see what you wish to get at. Will you kindly explain? One cannot carry these things in his head for years, and you must excuse me if I do not quite understand you, and do not wish to commit myself before I understand the drift of your questions.

599. What I wanted to establish was the exact extent to which each party was responsible for the delay and not to throw all the blame on the suggestion of opposition behind the scenes, or anything of that kind. —I have no wish to shelter myself behind anybody, but as I stated the position it is perfectly correct—that the Government withheld its sanction from the plans originally filed because the matter was proceeding in the way I stated there. After the vote was taken by the Sanitary Board, which was approximately the date you mentioned, the matter took a new form altogether. We then approached the Government and sought to obtain Government aid in order to establish a company, which they sanctioned by their contract of October 6th. Meantime engineers had come out to examine the plans we originally filed, and they decided to proceed on somewhat different lines, and were making new plans with the cognisance of the Government, the Government understanding every step that we took; and consequently the statement I made here is perfectly sound and correct, because the plans were kept in abeyance by the Government on the grounds I have stated.

600. I take it that as a matter of fact it was to your advantage that the Government should keep that approval in abeyance I will tell you what I mean: If in 1893, when you put in the plans the Government confirmed them, it would then be necessary to finish your work within two years from then?—If they approved of them.

601. But I think I am right in saying that up till 1897 you never succeeded in making financial arrangements which would enable you to carry out the scheme?—We were ready in 1896 when we were waiting for the fresh plan the French engineer was making.

602. Do I understand that you had so far completed your arrangements with the financiers that work could have been begun in 1896 if the plans had been approved of? —That I am quite clear of. The delays arose over the arrangements between the Government and the French people.

603. You recollect, of course, that in 1896 you got the approval of the Government to issue debentures at 96 in Paris. Immediately after that you came to the Government with a fresh proposal which put the whole thing on a new financial basis?—No, it arose from the wording of the contract which stated that we had to have £600,000 always available for the purposes of the Company. It was so loosely worded that nobody could understand it.

604. You remember that shortly after this you came to the Government with a proposal for doing away with the four per cent. guarantee on debentures and transferring the four per cent. guarantee to preference shares. All that suggests to my mind that your financial arrangements were so incomplete that, if your plans were approved of, you could not have proceeded with the work any time prior to 1897.—We may have had a discussion with the Government arising over the view that it might have been better to finance by preference shares rather than debentures. That is quite possible.

605. May I take it that before September, 1899, you were in a position to make final arrangements with your financial friends which would entitle you to undertake the work?—Yes, we had contracts drawn up and everything ready for action, but the political troubles became so great that we had to withdraw.

606. These contracts referred to the floating of the Company?—Yes.

607. The Government had already gone so far that they had nominated one Director —Mr. Boeschoten?—Yes.

608. Did he begin to draw his salary?—No, he drew no salary.

609. Do not answer this if you are not at liberty to do it. You said something about being prepared to treat with a Commission or a Water Board if it is established as a settled principle that we are not going to have any private Company concerned in the supply of water. I infer from that that at the present moment you are under no financial obligations which would prevent you dealing?—The moment the Commission states they will not proceed with a scheme by means of a private Company I will naturally have to tell my people we can proceed no further.

610. You will then be free?—Then I will be free.

611. And I take it that if the Commission definitely states that, you would probably be prepared to make a proposal to them?—Certainly.

612. Not of course in evidence, which would not be a satisfactory way of discussing the matter. You would probably not be prepared to do that, and I think I may say on behalf of the Commission that any reasonable proposal put forward by you would receive very careful consideration. Thank you, Mr. Goch.

(*The Chairman.*) The next witness is to give information on a scheme to provide water from the Vaal River. I understand that the promoters of this Vaal River scheme

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have applied to be represented by Mr. Bell. The Commission, Mr. Bell, agreed to your being allowed to represent the promoters of this scheme during their examination, and I daresay you will be ready to lead evidence by way of assisting the Commission. Who are your witnesses?

(*Mr. Bell.*) Mr. Cousens and Mr. Bennett. There is one other witness, Mr. Halse, who is now in the Cape Colony. Permits have been sent down to him, but somehow or other they have not reached him. Every effort has been made to get him here, but he has not turned up, so we will have to ask the Commission for a postponement in order that he may be called.

(*The Chairman.*) Yes, from what I know of the facts it is rather important that Mr. Halse should be here. I may say that everything has been done that we could to get a permit sent down to him. Why it has not succeeded in reaching him I do not know.

(*Mr. Raubenheimer.*) I wrote to the Commission and received a reply from the Secretary that an answer would be given me this morning in regard to my application for permission to appear on behalf of certain riparian owners in connection with the Wonderfontein scheme.

(*The Chairman.*) If you had been here at the beginning of the proceedings I was prepared to inform you. The Commission have considered your application. Your proper course would be to give evidence with regard to the position of the riparian owners, and the Commission would be very pleased to receive that evidence and also the evidence of any other persons whose agricultural operations may be affected by any scheme put before us.

(*Mr. Raubenheimer.*) When will that opportunity be given?

(*The Chairman.*) For that you must communicate with the Secretary, and he will fix a day for your being heard.

(*Mr. Raubenheimer.*) Thank you. I must apologise for unfortunately being absent when the meeting started.

VAAL RIVER SCHEME.

Mr. Richard Lewis Cousens, called and examined:

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613. (*Mr. Bell*, representing the promoters of the Vaal River Scheme.) Will you state your qualifications?—I am a member of the Institute of Electrical Engineers, and at the present time a Consulting Engineer.

614. You have had some experience as such?—Yes.

615. Your scheme refers to a proposition for getting water out of the Vaal River?—It does.

616. Will you state shortly the locality from which you propose to draw this water?—It is at Engelbrecht's Drift, about 12 miles from Vereeniging, and a point 5¼ miles further up the river.

617. Your scheme consists of two parts?—Yes.

618. Will you say what they are?—Yes. the proposed scheme is to divert the water from the Vaal River.

619. There is a smaller and a larger *scheme?—Yes.

620. Is this the larger or the smaller scheme you are about to refer to?—The smaller. The proposed scheme is to divert the water from the Vaal River by means of a dam or weir placed across the river into a canal constructed for the purpose to pipes leading to turbines, taking advantage of the falls between Engelbrecht's Drift and a point 5¼ miles above this latter place, the difference in level between the two points being 90 feet. The difference in level between Engelbrecht's Drift and any point along the Reef, is about 1,200 feet, and it is proposed to raise the water required to any desired point in two lifts, making an intermediate station, say, at the Black Reef (farm Roodekop). The water pumped to this intermediate station would be by pumps actuated by turbines direct, and that pumped from the intermediate station to any point or points along the Reef would be by pumps driven by electric motors, the latter being supplied by electric power from dynamos actuated by turbines located at the river station. In order to pump the amount referred to, namely, ten million gallons per diem, in two lifts, an amount of about 6,000 horse-power will be required, allowing a liberal margin for all losses in transmission. This amount of power, with 80 feet fall (the net effective fall at the turbines), will require about 50,000 cubic feet of water flowing per minute. As a rule the amount of water flowing in the Vaal River far exceeds this amount, but should the quantity in times of drought be less than the amount stated, means can be adopted for storing a vast quantity of water by raising the dam or weir at the head of the canal to a height of say 30 feet, which would dam back the water for a length of several miles up the river, which reserve could be drawn upon at any desired time. The advantages of the scheme are:—(*a*) that all pumping can be done by means of water power, which effects a saving over pumping by steam power of about £20,000 per annum, calculating the cost of the coal at only five shillings per ton; (*b*) that by continuing a contour canal from the head of the pipe lines to turbines there is an area of ground available for irrigation of 48 square miles. The 60 feet dam at the head of the falls will hold 7,128,000,000 gallons of water. This would last 15 days, supplying water to turbines on the supposition that the river ceased to flow. That is briefly the small scheme on a basis of ten million gallons. The larger scheme is, briefly, to place a 120 feet dam at the foot of the falls, a height of 120 feet, instead of having the dam at the head of the falls with a contour canal. This is a very material condition which I shall go into.

* See Appendix E.

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621. (*The Chairman.*) You have done with the smaller scheme? What is the amount of water in the larger scheme?—I will go into that now.

622. (*Mr. Bell.*) You have given ten millions for the smaller, what is the amount for the larger scheme?—You can get it up to thirty millions.

623. Before you leave the smaller scheme I want you to state briefly your estimate of what it would cost?—Hydraulic works, £142,000; pumping and generating station, £56,470; overhead transmission line, £26,517; intermediate pumping station, £34,028; intermediate reservoir, 100 feet by 100 feet by 10 feet, £15,000; freight and delivery of machinery, £15,000; erection of machinery and plant, including foundations, £40,000; contingencies, £10,000. That is a total of £339,015. Forty miles of 30 inch pipe line laid and erected, £450,000; total, £789,015. To holders of riparian rights contracts, £25,000; total, £814,015. That is the cost of the smaller scheme. The larger scheme will cost £308,000 more. That is arrived at in this way: Cost of the large dam at the foot of the falls and all appliances, £450,000, from which is deducted the cost of the canal, small reservoir, etc., of the smaller scheme, which would be unnecessary. That added to the £789,015 is a total of £1,097,015. Then to holders of riparian rights contracts there would be £25,000, which makes a grand total of £1,122,015.

624. Let us go on with the smaller scheme now, Mr. Cousens. In this smaller scheme you propose to pump ten million gallons per diem throughout the year?—Yes.

625. In two lifts?—Yes.

626. How do you propose to work the second lift?—By electric power transmitted from the river station.

627. (*The Chairman.*) What is the distance of the proposed intermediate station?—About 35 miles from the river and about 5 miles from the main line of reef.

628. (*Mr. Bell.*) Have you estimated the amount of horse-power required?—Yes.

629. What is it?—About 6,000 horse-power. That is on the basis of ten million gallons.

630. And what amount of water will you require to drive the turbines to generate that power?—50,000 cubic feet.

631. The Commission likes us to give it in gallons.—It is six-and-a-quarter times that—about 320,000 gallons.

632. Now, will you have sufficient water in the Vaal River for that purpose?—Yes, by providing adequate storage.

633. Can you tell us how you propose to do it?—Under the head of storage, I propose to erect a 60-feet dam at the head of the falls to hold 7,128 million gallons of water. That would be sufficient to last for fifteen days supplying water to the turbines on the supposition that the Vaal River ceased to flow altogether.

634. When it does flow how do you propose to deal with it then? I want to know how you propose to get this water. You are only dealing with fifteen days supply?—You mean how we are to get the power?

635. Sufficient water?—We divert the water through a contour canal, which runs alongside the river.

636. You told us that you required 50,000 cubic feet of water. That is equal to 300,000 gallons per minute. I want to know how you get that water. How would you get it out of the Vaal River and conserve it?—We first of all erect a dam 60 feet high at the head of the falls.

637. Which gives you the 50,000 cubic feet?—Yes.

638. For the rest?—We get it from the Vaal River.

639. Have you measured the river?—I have made frequent measurements during the last ten years, and these show an average in excess of 150,000 cubic feet per minute—937,500 gallons per minute. This may be taken as an ordinary flow exclusive of any increase in times of floods.

640. So that you estimate that there would be sufficient water for your purposes?—Yes.

641. Now, will you tell us about the canal?—The 60-feet dam would be erected at the head of the falls, and a contour canal would run alongside the river as shown on the plan.* From the end of that canal certain pipes would be run and would bring the water down to the turbines.

642. The distance being?—The length of the canal is about 5¼ miles, and the length of the pipe line to the turbines a quarter-of-a-mile.

643. And the net fall?—The net fall to the turbines would be 80 feet under the smaller scheme.

644. And that would generate sufficient power for your purposes?—Yes.

645. Now let us get on to the larger scheme. Will you say briefly what the storage capacity of the larger scheme is?—The larger scheme is to construct a 120-feet dam at the foot of the falls, and this, I estimate, would hold 209,088 million gallons.

646. (*The Chairman.*) Is this also a turbine scheme?—Yes.

647. (*Mr. Bell.*) Turbines driven partly by water power?—Yes.

648. How long would the quantity of water you mention supply the turbines?—That would last for eighteen months if the height of water was maintained in the dam (*i.e.*, if pressure equal to the full dam was maintained), supposing the river ceased to flow, but making allowance for decreased height of water in the dam as storage water is drawn upon, a deduction of 50 per cent. is made, thus showing the storage equal to nine months' supply assuming the river ceased to flow.

649. That is also on a ten million scheme?—Yes. Or you can get up to 30 millions if you want it. The lake formed by the dam would cover an area of from 30 to 40 square miles. These figures I may say are those of Mr. George Forbes, one of the Consulting Engineers of the Niagara power

* Not printed.

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scheme. He was out here a few years ago, and he went with me to the site of the proposed works, and he calculated that the artificial lake would cover an area of from 30 to 40 square miles. He writes:

"Number 3, (which is the scheme alluded to) has the great advantage that the dam forms a lake which I estimate as at least 30 or 40 square miles, forming a magnificent site for a residential suburb of Johannesburg. The power supplied can be supplemented by an irrigation scheme at a small extra cost, while the power supplied at ¾d. per horse-power per hour, would render a magnificent dividend."

These last figures refer to the transmission scheme pure and simple.

650. Still on the storage point. You say that this dam at the head of the falls would, if necessary, yield a supply of 30 million gallons a-day?

651. (*The Chairman.*) At the head of the falls?—At the foot of the falls.

652. (*Mr. Bell.*) What is the lowest measurement you have taken at the Vaal River?—The lowest measurement I have taken, at a very dry period, in September, 1895, was 11,000 cubic feet of water per minute equal to 70,000 gallons per minute.

653. In what respect does this large scheme differ from the smaller one in connection with the motor power?—It concentrates all the hydraulic works at the one point, and you have everything more under control, and of course the storage is far greater.

654. But what I want to get at is this; instead of bringing the water down by means of a canal you pump the water from a dam?—Yes, we bring it down in pipes.

655. From the turbines the water is sent up to the intermediate pumping station, and the rest of the scheme is the same as you have detailed in connection with the smaller scheme?—Yes.

656. Now in case it should be necessary to use steam power, what do you estimate the additional cost of plant would be?—£30,000 above the cost of water-power plant.

657. And in regard to fuel, would there be any difficulty about that?—No, there would be no difficulty if it should be necessary to use steam power for pumping—a contingency most unlikely to arise. There is a seam of coal exposed in the bed of the river, close to the pumping station, so that the coal should not cost more than 5s. per ton at that point. Comparing that with pumping at Wonderfontein, I have calculated that the cost of pumping at Wonderfontein on the basis of ten million gallons per diem would be over £100,000 per annum. That estimate is based on the cost of coal as it was before the war. On the West Rand coal cost about £2 per ton. Going on these figures, and considering the height the water has to be pumped up from Wonderfontein, coal, I calculate, will cost over £100,000 per annum.

658. Now there is the question of filtration. How do you propose to deal with that?—By means of the lake the water would, to a large extent, be filtered by subsidence, *i.e.*, particles of matter held in suspension will on reaching the lake subside to the bottom. This is proved in various parts of the world where rivers run into or through lakes For example, where the river Rhone enters the lake of Geneva it is muddy and turbid; where it leaves the lake it is bright and clear, having been perfectly filtered. I can also point to a local instance where the same process takes place, namely, the Rand Mines dam. Very often the water enters the dam turbid and foul, but near the wall of the dam the water is quite clear. If further filtration is required for water used for town purposes it could be filtered at the supply reservoirs of the town in the usual manner in sand filter beds. The cost of filtration beds is very small. Mr. Willcocks says the cost of filtration including cost of supply to the Company at Cairo is sixpence per 1,000 gallons. Water required for the mines would not need special filtration. Now, in confirmation of what I have just stated, I have here a book with the title: "Water and its Purification. A handbook for the use of local authorities, sanitary officers, and others interested in water supply. By Samuel Rideal, D. Sc. (Lond.), Fellow of University College, London; Fellow of the Institute of Chemistry; Examiner in Chemistry to the Royal College of Physicians; Public Analyst for the Lewisham District Board of Works; Water Examiner to the Guildford Rural District Council; Author of Disinfection and Disinfectants." It is dated 1897, and is one of the very latest books on the subject. On page 13 he says:

> "Suspended particles, if of an appreciable size, soon sink to the bottom and constitute a sediment, from which the water may be poured off in a clear state. In depositing, the suspended matter may carry down with it most of the minute animals, algae, and even bacteria, so that an examination of this deposit by the microscope is of great value in revealing the nature of the solid impurities present. By such deposition rivers become to a certain extent purified in the quieter tracts of their flow, and become clear."

On page 117 he says:

> "An example of the effect of depth and stillness in attaining clarification is furnished by the River Rhone, which enters the Lake of Geneva full of suspended matter, but emerges clear and bright. To increase the storage capacity of a natural reservoir such as a lake, and also to form one where the sides of the valley through which a stream flows are sufficiently impervious, an embankment is built across the outlet. Reservoirs of the kind are very common in the United States, where small lakes are plentiful. Manchester is also supplied from Longerdale Valley by six storage reservoirs, arranged in steps,

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with dams 70 to 100 feet high. The Bolton embankment at Entwistle is 120 feet deep, while one at Villar, Madrid, in Spain, is 158 feet, and another at St. Etienne, in France, is 164 feet. The new Waterworks of the Bradford Corporation include a reservoir at Gouthwaite, covering 330 acres, which is the same area as Thirlmere. It is over two miles in length, holds more than 1,500 million gallons of water, and is said to add considerably to the beauty of the valley."

I quote the name of these places because I wish to bring forward the point that lakes through which rivers, or streams flow are a favourite source of water supply to towns both in England and America. On page 146 he says:

"The common process of subsidence effected in settling tanks and reservoirs accomplishes the almost complete removal of suspended solid mineral matters, and with them a large proportion of the living organisms. Thus, Dr. Percy Frankland, in an examination of the intake waters of the West Middlesex Company, found 1,437 bacteria per cubic centimetre, whilst after passing through one storage reservoir the number was reduced to 318, and after traversing a second reservoir there remained only 177 per cubic centimetre."

659. Now, will you tell the Commission what you have to say about the purity of the water?—Surface water is greatly improved by æration and sunlight. This operation is fulfilled by spreading the water over a large area by means of a lake. On the other hand it has been demonstrated that water pumped from underground sources should on no account be exposed in open reservoirs as it would thereby cultivate algæ and bacteria. I need hardly add that the cost of covered reservoirs is far greater than that of open reservoirs. Mr. Bennett, who follows me, will give additional particulars on that point. I will again quote from the same authority, with your permission. On page 122 Mr. Rideal says:

"The improvement of water in reservoirs is largely due to the deposition of suspended mineral matter and bacteria, but, in addition, open storage favours the beneficial action of æration and light."

On page 123 he says:

"The Massachussetts Board, after lengthened experiments, concluded that while surface waters were generally improved by storing in open reservoirs or tanks, ground or subsoil waters underwent rapid deterioration from algæ unless kept in the dark. They also conclude that the 'colour of water exposed to the sun in open reservoirs is reduced by storage; but it must be stored for several months to cause any material reduction of colour, and from six months to a year to remove practically all of it.' Deep well waters are not improved by storage, but are better delivered as pumped, provided they are clear, which is almost always the case after the well has been worked for some time. It has already been pointed out that pathogenic and other bacteria multiply in them with great rapidity. At their source they do not usually contain more than two or three bacteria per cubic centimetre, and these have probably got in mainly by accident. But on exposure for a few hours in any vessel there will be hundreds of bacteria, and perhaps millions in two or three days, after which they will diminish by mutual exhaustion and destruction. Surface water on the other hand does not show any such multiplication, this change having taken place to its fullest extent during the previous history of the water. It may be summed up that the only waters which deteriorate on storage in properly prepared reservoirs are those which are filtered or taken from subterranean sources. When they must be stored they should be kept in closed reservoirs arched over."

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(*The Chairman.*) I do not wish to interrupt the witness, but this is rather foreign to our inquiry. I do not wish to stop him, if you, Mr. Bell, think it is essential to the presentation of your case to go on with these extracts.

(*Mr. Bell.*) I think some of these opinions are essential.

(*The Chairman.*) Very well, I leave it to you.

(*Witness.*) The last paragraph reads:

"But surface waters are never injured by proper storage; on the contrary, in the great majority of cases they are very materially improved."

660. (*Mr. Bell.*) I think you might leave the rest of these extracts and get on to this question of the purity of the water.—The Vaal River water is soft and free from lime and deleterious acids, and is thus most suitable for boiler purposes and amalgamation; whereas water from the dolomite formation in this district contains bi-carbonate of lime, and in places is acidulated by decomposition of iron and copper pyrites brought by infiltration from adjacent beds of rock, and and is therefore most unsuitable for boiler and amalgamation purposes. When water from the dolomite formation is boiled the bi-carbonate is precipitated in a solid form, depositing a crust of lime on the boiler tubes, whilst the acids in the water cause rapid eating away of the metal with which they come in contact. As practical examples of the above theory, it may be mentioned that the Orion Gold Mining Company, whose property is situated on the Black Reef, which underlies the dolomite beds, found the tubes of their boilers were eaten away in a few days when using the water from their mine. They then tried filtration which did not

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answer, owing to the acids in the water. At length they got over the difficulty by running supply pipes up to the Natal Spruit and obtaining their boiler water from that stream. The East Orion Gold Mines had a similar experience, a heavy deposit of lime being formed round the tubes which also leaked badly. The evil of incrustration of lime can be obviated to a large extent by the use of condensers and water-softening appliances. It is not every company that has condensers, and water-softening appliances are not in general use. Apparatus of this description is an expensive item. Prevention is better than cure, therefore use Vaal River water. There is one quotation I would like to make with reference to lime water:

> "If the water has 15 degrees of hardness, the deposit per working day will weigh 6½ pounds, or over a ton per annum, of which the larger portion will remain as scale, equal to 35 cubic feet of soft or 17 of hard scale."

Then it is estimated that one-sixth of an inch of scale necessitates the use of 16 per cent. more fuel; one quarter of an inch 50 per cent.; and half-an-inch 150 per cent. additional coal. For domestic purposes the water from dolomite formation is not nearly so good as river water. This is shown by the City of Glasgow water supply, where, as the result of a commission of inquiry, it was decided to introduce water from Loch Katrine (soft water) in preference to certain springs in limestone formation (hard water), because they estimated that it would be a saving to the inhabitants of the city of over £100,000 per annum by using water from the Loch, these figures representing the economy effected by its use in conjunction with soap and alkalis and in the consumption of tea.

The witness then put in the following extracts from Mr. Samuel Rideal's Book, "Water and its Purification," (pp. 194 to 196):—

> "For industrial and general domestic uses, a hard water has very serious disadvantages. The waste of soap alone is generally stated to amount to twelve pounds per 10,000 gallons of water for every degree of hardness. From the author's experiments and from calculation, the quantity is probably rather less than the above, but may be safely estimated as from nine to ten pounds per 10,000 gallons for every degree. Not only does a hard water cause this serious waste, but the curd produced occasions a greasy deposit in sinks, pipes and utensils and *forms one of the difficulties in dealing with sewage.* When soda is added in washing to overcome the hardness, the fabrics are more or less injured, and insoluble earthy soaps are left in the fibre. For most industrial purposes a soft water is indispensable, and with the exception of London, all great manufacturing centres have soft supplies. The woollen trade of Bradford would be seriously affected if that town had a hard water supplied to it; and, (as already mentioned) Glasgow is estimated to save £36,000 annually in the matter of soap since using Loch Katrine water.
>
> "In cooking, a hard water is objectionable as a deposit of lime salts is formed upon the surface of tea leaves, meat, vegetables, &c., which hinders their extraction or hardens their tissues. It has been asserted that 'ten ounces of tea made with soft water is as strong as eighteen ounces brewed with hard water'; and Mr. Soyer, in his evidence before a Royal Commission proved that in the making of soup more meat is required with a hard water, and the operation takes a longer time. Vegetables have their colour darkened by the action of the carbonite of lime. For these reasons it is a common practice to add a little bi-carbonate of soda to the water in culinary operations, In baking the dough rises better, and bread is lighter in colour when soft water is used.
>
> "Brewers and distillers find a soft water very desirable, as, when the water has a high temporary hardness, the refrigerators become coated with a non-conducting scale of carbonite of lime mixed with organic matter, which is often very thick and difficult to remove. The presence of a large quantity of carbonate of lime makes the water alkaline, and so hinders the fermentation, and favours the growth of unhealthy organisms."

Page 219.—"In kitchen boilers the use of a hard water occasions continual trouble and expense, and great danger of explosion. If rain-water apparatus cannot be obtained or a softer local supply, some form of automatic softener will become necessary.

Page 282. Table "D."—"Order of the rocks and characteristics of water derived from them:—

Sub-divisions: Magnesian, Limestone, or Dolomite.	"Furnishes an abundant yield in places, but the water shows high permanent hardness from the presence of lime and magnesian salts, and is apt to be salt, bitter, and unwholesome. The thickness of the strata, and therefore depth of sinking vary very greatly, and there is also great interference from faults."

661. Now you have something to tell the Commission about the contamination of water?—As to the contamination of the water it has been alleged by Mr. Goch

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that the flow of water to the south of the Rand, including the Heidelberg District, whether from rainfall or otherwise, would carry away with it into the Vaal River certain of the cyanide solution remaining in the tailings dumps, thus polluting the proposed Vaal River water supply, and implying that the water in the dolomite formation is superior in this respect. This is impossible because (1) the dolomite formation exists between the Rand and the Vaal River, and Mr. Willcocks states in his evidence that water flowing from the Rand is to a large extent caught by the dolomite formation and held there. It follows, therefore, that by these means the water in the dolomite formation would be more contaminated than that in the Vaal River; and (2) that all water flowing from Johannesburg and east of it, including the Heidelberg District, not caught by the dolomite formation flows naturally into the Klip River or the Zuikerbosch River which form their junction at a point below the site of the proposed Vaal River Water Supply Works. It is, therefore, impossible for the water from this source to be contaminated by cyanide.

662. Now as to sewerage?—As to sewerage, Mr. Willcocks in answer to Question 136, advocates the dry earth system for Johannesburg in preference to a sewerage scheme, because he thinks the sewerage water will flow into the streams from which the drinking water is drawn, and that however much the outflow is purified it will contaminate the springs in time. It will be seen that such a remark can only apply to water drawn from other sources than that of the proposed Vaal River water supply, because the country south of Johannesburg and east of it, including the Heidelberg district, is drained by the Klip and Zuikerbosch Rivers, which form their junction with the Vaal at a point below the site of the proposed works of the Vaal River water supply. The site of the proposed works not being on the dolomite formation, there is no risk of contamination by infiltration, and there will be a total absence of bi-carbonate of lime.

663. How would riparian rights be affected by this scheme?—The riparian rights on either side of the Vaal River covering the area required for the works of the scheme have been fully secured, and copies of documents lodged with the Commission. The lower proprietors are protected by the fact that we cannot possibly pump out more than 5 per cent. of the total amount of water available while pumping by water power. For example, to pump ten million gallons of water per diem it would be necessary, to use for power purposes 230,000 gallons per minute under the larger scheme, which would flow down the river, whereas the lowest measurement I have made (in September, 1895), of Vaal River, at the point in question, was 70,000 gallons per minute, thus benefitting the lower proprietors by means of conserved water to the extent of 160,000 gallons per minute in very dry seasons.

664. The point you wish to make is this, as I understand it, that with these turbines and with this fall of water into the turbines you cannot under the circumstances pump more than 5 per cent. of the water from the lake?—Yes. Mr. R. L. Cousens December 16, 1901.

665. The rest goes down the river?—The rest goes down the river.

666. Now will you tell the Commission shortly what you have to say as to the use of this water for irrigation purposes?

(*The Chairman.*) Irrigation seems to be quite outside the scope of our inquiry.

(*Mr. Bell.*) It is only to show one of the uses to which this surplus water could be applied. There is such a vast quantity of water accumulated in this enormous lake that part of it can be used for irrigation purposes on both sides of the Vaal River to a very great extent.

(*The Chairman.*) Very well, if you can give it to us shortly.

(*Witness.*) An area of approximately 48 square miles would be available below the dam under the larger scheme, and below the head of the pipe line under the smaller scheme, for irrigation purposes on the north side of the river. The length of the canal would be about 20 miles, and the greatest distance from the river would be 7 to 8 miles; the sectional area of the canal being about 20 square feet. The cost of such a canal with certain storage reservoirs is estimated at £75,000. The income to be derived is based on a charge of £3 per acre per annum on that portion requiring a constant supply of water, and £1 per acre per annum on that portion requiring water for one crop only; that is to say, 10,000 acres at £3 per acre per annum, and 10,000 acres at £1 per acre per annum, making a total of £40,000. The 20,000 acres here quoted represent only two-thirds of the area of 48 square miles. Working cost is estimated at:—

Repairs to canal, scouring same &c.	£7,500
Management	2,500
	£10,000

Thus leaving a profit of £30,000 per annum. The water required would be 27,000,000 gallons per diem.

667. (*Mr. Bell.*) On the other side of the river the scheme is very much the same?—Yes, very much the same. The estimated profit would be £19,000, and the quantity of water required would be 20,250,000 gallons per diem.

668. You and those associated with you have secured a number of contracts reserving to you certain riparian rights?—Yes.

669. For laying out this canal?—Yes, and taking the water out of the river.

670. These contracts you have handed in to the Commission?—Yes.

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Mr. R. L. Cousens. December 16, 1901.

671. Now what are the advantages you claim for this scheme?—The advantages claimed for it are:

(*a*). The larger scheme provides for storage of 209,088 million gallons of water and ensures an ample supply of good water for all purposes to the extent of a supply of 30 million gallons of water per diem.

(*b*). The larger scheme concentrates all hydraulic works at one point, thus effecting a saving in working cost.

(*c*). River water is far superior for household, steam, and amalgamation purposes to water taken from the dolomite formation.

(*d*). The working expenses of the scheme must be lower than any other scheme, because all pumping is done by water power.

(*e*). The larger scheme ensures a regular flow down the river at all times of not less than 330 million gallons of water per diem, as against 100 million gallons at the time I measured the flow in September, 1895.

(*f*). It enables profitable and extensive irrigation works to be carried out at comparatively small cost, tending to the welfare of the two Colonies interested in that portion of the river.

(*g*). It provides for a supply of water at and about Johannesburg at the rate of 2s. per 1,000 gallons. The figures show that this price yields a profit of 50 per cent. over working cost and interest. It is, therefore, fair to assume that if the Government or the Municipality undertook the scheme they could supply water in bulk at about 1s. per 1,000 gallons.

672. There is only one other question that I wish to ask, and that is with regard to these figures you have submitted. These are reliable?—Yes. We are prepared to carry out the work at the figures we quote here.

(*The Chairman.*) Is Mr. Cousens resident here? Can he appear on a subsequent occasion?

(*Mr. Bell.*) He would be here again in about two months' time.

(*The Chairman.*) Mr. Cousens' evidence is distinctly technical, and I think it would be rather difficult for any one to put questions to him until they have seen this evidence in print. Especially as Mr. Halse is not here, from whom we expect to get more information with regard to the reasons which induced you to appear before us at all. I think it would be desirable that Mr. Cousens' examination should be postponed for some time.

Mr. Cousens said he was leaving Johannesburg at the end of the week.

(*Mr. C. T. Thomson.*) I have no questions.

(*Mr. W. F. Lance.*) I think it would be better to postpone the further examination of Mr. Cousens.

(*Mr. Bell.*) The only thing is Mr. Cousens has arranged to leave for the Cape Colony this week.

The Chairman pointed out that the scheme was likely to receive more careful consideration if the examination of Mr. Cousens was postponed. (*To Mr. Bell*): What about your other witnesses?

(*Mr. Bell.*) Mr. Bennett is from Capetown, and he also will be technical. If you allow that question to stand over until after luncheon, I would be able to tell you more definitely about Mr. Cousens' movements.

(*The Chairman.*) I think you will prejudice the interests of your own scheme if we are obliged to put our questions to Mr. Cousens now and finish his examination, because the matter has not been presented in such a way that one can grasp it readily.

The Commission adjourned for Luncheon.

ON RESUMING,

(*The Chairman*) said: We think it best. Mr. Bell, not to attempt to examine Mr. Cousens at the present moment. If you will lead Mr. Bennett's evidence we will then postpone the further examination of the two witnesses, and I hope we shall be able to get Mr. Halse in the meantime.

(*Mr. Bell.*) Mr. Cousens has arranged to stay over until the 30th if that would suit the Commission.

(*The Chairman.*) If we can get Mr. Halse by then.

(*Mr. Bell.*) Every effort is still being made to get Mr. Halse up. I should think that by that time he would be here.

(*The Chairman.*) I think we ought to have Mr. Halse's evidence before we attempt to examine any of your witnesses. I should hope that by our united efforts we may get him up.

Mr. THOMAS BENNETT, called and examined:

Mr. T. Bennett. December 16, 1901.

673. (*Mr. Bell.*) Will you state briefly your qualifications please?—I am a civil engineer and manager of the Capetown District Waterworks, recently the Waterworks Company, and now under the Municipal authorities, and I have had upwards of 30 years' experience in the designing and managing of waterworks.

674. You have considered this scheme as submitted by Mr. Cousens. I believe?—Yes.

675. And you have written a report thereon?—Would you read that to the Commission. I think, sir, this would be the shortest way to get through Mr. Bennett's evidence, and also the best, because he has got his statement written quite exactly.

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(*Witness*), reading: "I have carefully examined the plans, drawings, and estimates prepared by Mr. Cousens, and entirely concur with him as to the value and excellence of the scheme, commencing with a point 5½ miles above Engelbrecht's Drift and having a fall, between the two points A and B, of 80 feet. The difference between Engelbrecht's Drift and the Main Reef on the Witwatersrand being 1,200 feet. It is proposed to raise the water required to any point desired in two lifts, making an intermediate station, say, at the Black Reef. The water pumped to this intermediate station, would be by pumps actuated by turbines direct, and that pumped from the intermediate station to any point or points along the Reef would be by pumps driven by electric motors, the latter being supplied by electric power from dynamos actuated by turbines located at the river station.

"I think that the plans have been very carefully considered and worked out in all their bearings.

"That the quality of water has been ascertained (by numerous gaugings extending over a series of years) to be ample and sufficient, and by the construction of a dam, having a height of 120 feet at the foot of the falls, would form a lake having an area of about 40 square miles, with an average depth of about 40 feet, and containing upwards of 209,088,000,000 gallons, sufficient for at least eighteen months.

"This water can be used for power purposes alone, or for domestic in addition. For manufacturing and domestic purposes this water would have very great advantages over a hard water; it being well known that in the saving of labour, soap, and the great advantage to dyers, bleachers, steaming and other purposes, is enormous.

"In Glasgow alone since the introduction of the 'Loch Katrine' water, the saving of soap alone used in manufacturing and domestic purposes is estimated at upwards of £38,000 annually. When water is procured from wells it is simply that portion which passes downwards through porous strata, and is stored in the crevices and pores of the various formations suitable for its reception. When the strata passed through by the water are of limestone, a portion is dissolved, and waters derived from these formations are said to be hard, that is, they contain various salts in solution, in consequence of which they have a harsh feeling when used for personal ablution, and much soap is destroyed in artificially softening them.

"The hardness of water is expressed in degrees, and 1 lb. of carbonate of lime, or its equivalent of other hardening salts in 100,000 lbs., or 10,000 gallons of water, is equal to 1 degree of hardness, and 12 lbs. of best hard soap will be destroyed in 10,000 gallons of water when used for washing, by each pound of hardening salt. That hard water is very destructive to steam-boilers is well known.

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"Possibly objection may be taken to the fact that the water is proposed to be taken from the river and collected in a large storage-reservoir or lake, and would require to be filtered. Five of the great London water supply companies take their supplies direct from the Thames, and with the great improvements in the construction of filters during recent years, experience shows that such water may be rendered wholesome and fit for domestic purposes.

"Filtration, to be effective, should not exceed 2½ gallons per square foot of area per hour, or say 540 gallons per square yard per twenty-four hours, equal to an area of 18,500 square yards for the proper filtration of 10,000,000 gallons per day.

"The cost of filtration will not exceed 1½d. per 1,000 gallons. The 'life' of a filter is, of course, determined by the quality of the water turned in and treated, and may be found to vary between a week and two months. I am of opinion that the Vaal River Scheme, is particularly fortunate with regard to economy of filtration. It is well known that when large volumes of water pass in a turbid or muddy state into large impounding reservoirs or lakes, the water becomes quite bright and clear; for instance, the River Rhone enters the Lake of Geneva in a muddy, turbid state, and discharges perfectly clear and bright. This will apply to the Vaal River water, consequently the cost of filtration will be practically nil. There are also instances in the large towns and cities in Great Britain where the water is not filtered—Liverpool, Manchester, Glasgow, Bradford, etc.—the water in each case being stored in impounding reservoirs.

"Quantity.—With reference to the quantity of water to be provided, authorities differ. The subject of the use and misuse of water, apart from that of waste arising from defective pipes, cisterns, and taps, is intimately connected with the climatic conditions and geological formation of any given locality, and with the habits of the residents. Hence, on this account, analogies between the requirements of widely separated districts are frequently imperfect, and each one must be studied on its own peculiar merits. The demands of trade and manufacturers are variable but highly important factors in fixing the proper amount of a supply of water; whilst, owing to the difficulty of assessing with accuracy the population of a given district at any stated time, and to the want of uniformity in the methods adopted to measure the water supplied, such statistics as are available can only be regarded as approximately correct, and cannot be made a basis for exact calculation.

"I think it may be instructive to present here a summary of the particulars of the water supply of a few towns in Great Britain—presenting a considerable range in point of size and industrial and commercial character.

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Mr. T. Bennett.

December 16, 1901.

Statement of Water Supply of Certain Towns in Great Britain.

Town.	Estimated Population Supplied.	Supply in Imp. Gals. per head per day.	Nature of Source of Supply.
London	5,260,000	33	Rivers, Springs, and Wells.
Manchester	950,000	22	Catchment.
Glasgow	850,000	50	Catchment.
Liverpool	770,000	26	Catchment, and Wells.
Birmingham	640,000	22	Rivers and Wells.
Bradford	400,000	25	Catchment.
Edinburgh	350,000	40	Catchment.
Brighton	180,000	33	Wells.
St. Helens	70,000	20	Wells.
Torquay	45,000	30	Springs.
Chester	40,000	28	River.
Exeter	40,000	38	River.

"For the sake of contrasting with the foregoing supplies, those of other water-works' systems differing considerably from them, I append similar information with regard to a few principal towns in the United States, and some towns of less size situated in the State of Massachussetts. The latter are selected because they are well authenticated, show a considerable range in size, and belong to a State that has exhibited a notable solicitude for sanitary progress.

Statement of Water Supply of Certain Towns in the United States.

Town.	Estimated Population Supplied.	Supply in Imp. Gals. per head per day.	Nature of Source of Supply.
New York	1,700,000	55	Rivers.
Philadelphia	1,000,000	80	Rivers.
Chicago	875,000	110	Lake.
Boston	490,000	63	Lake.
St. Louis	400,000	64	River.
Washington	160,000	125	River.
Worcester (Mass.)	69,000	56	Catchment.
Springfield	38,000	88	Catchment.

"It will be observed from the foregoing tables, that the quantity of water to be supplied is very largely governed by the climatic conditions under which the supply is required. It will be necessary to make ample provision for domestic purposes, especially having in view a system of main drainage works for the city. It is well known that we have no economy equal to the economy of preventible sickness and preventible mortality. The extent of the preventibility of sickness and mortality has to a large extent, been proved in towns where the death-rate was 28 to 30 or more per 1,000 of the population, by a partial application of sanitary principles, the death-rate has been reduced by one-half or by one-third. In the case of Croydon, where great difficulties were experienced, the death-rate has been reduced from 28 to 13 per 1,000 So that every life saved has a monetary value to the community. The ancients well appreciated the necessity of a copious supply of water, and, moreover, seem to have known the bearing that a pure supply had upon the health.

"The Romans especially, not only in their own country, but in the countries that they conquered, carried out works, the magnificence of which testifies to this day to their boldness and skill as engineers.

"There should, in fact, in connection with water supply, be much less consideration than there is of pounds, shillings, and pence, except in the matter of prevention of the waste of water. The question should not be, 'How cheaply can we get a supply of water?' but 'What is the very best supply of water that we can get at any price that it is practicable for us to pay?'

"This is so far as providing a plentiful supply of wholesome water for domestic purposes is concerned, so that the public health may be kept as good as possible.

"It is different in the case of supplying water for manufacturing purposes, or for purposes of luxury, such as gardens and fountains.

"Having regard to all the circumstances, I estimate the quantity for daily consumption for Johannesburg ought to be as follows:—

"Domestic supply, taking the population to be 100,000 at 30 gallons per head per day—3,000,000.

"Manufacturing—the basis being the manufacturing towns in England, at 12 gallons per head per day—1,200,000.

"Street watering—taken at 2 gallons per six square yards, and for the fire extinguishing purposes, making together a total of 25 gallons per head per day—2,500,000. Total: 6,700,000 gallons.

"With an increase of 100 per cent. in the population, the total quantity to be provided would be at the rate of 13,400,000 gallons per day.

"All hard waters ought to be counted as not only destructive to steam-boilers, but also to kitchen boilers; however, the use of a hard water occasions continued trouble and expense, and great danger of explosions, and ought to be softened, the cost of which will be 2d. per each degree of hardness per 1,000 gallons. As to the economy of softening, there can be no doubt. It is estimated that a farthing's worth of lime saves about 30s. worth of soap.

"It is well known that all water from wells or deep springs ought to be kept strictly from the light and air, and not delivered into open reservoirs or storage tanks but delivered into covered service reservoirs for distribution. The cost of construction of covered service reservoirs will, in the capital expenditure, amount to about 4d. per 1,000 gallons.

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"The great variation in hardness of waters received from different sources may be indicated by the following table:—

Table giving Approximate Hardness of Various Water Supplies.

Town.	Source.	Hardness on Clark's Scale.
London (West Kent Co.) . .	Wells— (Chalk).	25 degrees.
Manchester (Longendale). .	Catchment.	3 degrees.
Sunderland . .	Wells— (Dolomite).	30 degrees.

"It will be observed that the water from the dolomite formation at Wonderfontein is in accordance with the German scale—11·3 or English scale 21·50 hardness.

"As to the cost of pumping by steam-power I may mention that the working cost of the Suburban Municipal Waterworks (Capetown) including maintenance of machinery for pumping 40,725,000 gallons of water as per Albion Spring returns on the basis of taking the price of Welsh coal at 65s. per 2,240 lbs., the lift being 350 feet, and distance one mile and a half:—

Fuel cost per 1,000 gallons ...	2·133d.
Wages	·688
Oil, lights, etc.	·098
Total cost per 1,000 gallons...	2·919d."

(*The Chairman.*) I think we will defer Mr. Bennett's examination. I am not quite sure whether there is anything in his statement which would not be covered by our examination of Mr. Cousens, so that if it is any trouble for him to come back, I doubt if it would be necessary. But I think we must arrange to get Mr. Halse before we can go on with the examination of your witnesses, Mr. Bell.

(*Mr. Bell.*) Of course Mr. Bennett resides in Capetown, and it would be a matter of very great inconvenience for him to come up again.

(*The Chairman.*) I don't think the Commission will put any questions to this witness.

(*Mr. Lance*, representing the Johannesburg Town Council.) Might I, in case we do not have Mr. Bennett again, put one or two questions?

(*The Chairman.*) Yes.

676. (*Mr. Lance.*) You say, Mr. Bennett, that you thoroughly approve of Mr. Cousens' scheme, and that you have gone into all the engineering details?—Yes.

677. And you have considered the construction of this dam?—Yes.

678. It is a dam which will require an immense height of wall?

(*The Chairman.*) Don't you think, Mr. Lance, we had better go into that with Mr. Cousens when we examine him? We shall then have questions to put on the whole of the scheme. If we get into a discussion of the details with Mr. Bennett it would rather anticipate Mr. Cousens.

Mr. T. Bennett. December 16, 1901.

679. (*Mr. Lance.*) That is so. (*To witness.*) Take the question of filtration. You have given an estimate of the area required for filter beds as 18,500 square yards?—Yes, for ten million gallons.

680. Do you know the area required in London?—Yes.

681. Am I not correct in saying that the space required in London is three square yards for every 1,000 gallons per day?—That is practically what I say, in a sense.

682. I work it out then that the ten million scheme would require 30,000 square yards?—The water here is very different to water pumped from the Thames.

683. Do you consider the Vaal River water more pure than the Thames water?—Yes, with precipitation.

684. And on that fact you have based the smaller space for filtration?—Yes.

685. Are you aware what the Vaal River water costs to filter at Kimberley?—I have been told 3s.

686. Yes, 3s. per thousand gallons. Can you give any reason for that difference with your notes?—No; that is a position I cannot understand. I should think they have no means at Kimberley for storing the water so as to allow precipitation to take place. They possibly pump it direct from the river. I have not seen the Kimberley scheme myself.

687. They take the water at Kimberley direct out of the storage reservoir, which is sufficiently large to allow the water to settle?—I cannot conceive a storage reservoir with a capacity to meet the requirements of Kimberley being a small one, having regard to the filtration of the water. I should say they ought to have a very large storage reservoir.

688. Now, the Thames water is stored before it is filtered?—In some instances it is.

689. And you cannot explain this excessive cost of filtering the Vaal River water at Kimberley?—No, I cannot understand it.

690. (*Mr. C. T. Thomson*, representing the Johannesburg Waterworks Co.). I should like to put one or two questions. Mr. Bennett has given evidence as to the degree of hardness of the water, and I should like to ask him if he has seen an analysis of the water from the dolomite in the Transvaal?—No, I have not.

691. So your general statement on the subject is taken from the text-books?—No. I know what the analyses of the limestone waters at home are, but I have no experience of those out here.

692. (*The Chairman.*) You have not read the report of the Commission of 1895, which gave detailed analyses of the water?—You mean Dr. Kleiner's analyses?

693. The Transvaal Commission's report of 1895? You have not read that?—I have read that, Sir.

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Mr. T. Bennett. December 16, 1901.

694. (*Mr. Thomson.*) And I presume the hardness of dolomite water is not always the same in different parts of the world?—Probably not. It depends upon the composition of the lime, of course.

695. You have made no local inspection of the intended Vaal River scheme?—No, I have not.

696. You are not acquainted with the sites where the dams are to be made?—Of course I have taken Mr. Cousens' drawings and the reports of certain other engineers, and I made my calculations from them.

697. So your report is based entirely on the report of Mr. Cousens?—Yes.

698. Yo have had no data of your own to go upon?—No.

699. (*The Chairman.*) Mr. Bennett, I think you stated in reading your report that accurate gaugings of the Vaal had been taken extending over many years?—Yes.

700. Have you got those gaugings?—Mr. Cousens will have them.

(*The Chairman.*) Perhaps Mr. Cousens will hand them in on behalf of the promoters.

(*Mr. Bell*). He has only those gaugings spoken to this morning.

(*The Chairman.*) Will he hand them in?

(*Mr. Cousens.*) I have not got them with me in writing.

(*Mr. Bell.*) Mr. Cousens will make a more detailed scheme regarding these details and hand it in.

(*The Chairman.*) You realise, Mr. Bell, that these gaugings go to the root of the whole scheme. You will hand them in to the Secretary as soon as possible.

(*Mr. Bell.*) Quite so.

JOHANNESBURG TOWN COUNCIL.

Mr. H. F. E. PISTORIUS, called and examined:

Mr. H. F. E. Pistorius. December 16, 1901.

701. (*Mr. Lance*, representing the Johannesburg Town Council). Mr. Pistorius, you are a member of the Town Council?—I am.

702. And you are an old resident of Johannesburg?—Since 1892.

703. Now, when this Commission was appointed, what was the first step the Town Council took with the view of bringing the requirements of the town before the Commission?—They appointed a Water Committee.

704. And of that Committee you were appointed Chairman?—I was.

705. That Committee went very fully into the question and looked up various statistics upon it?—Yes.

706. They obtained statistics from England, America, and other South African towns?—They did.

707. These statistics will be presented by the Town Engineer?—Yes, the Town Engineer will give further details with regard to these.

708. This Water Committee, after giving the matter very careful consideration, brought up a report for consideration by the Town Council?—Yes, and the Town Council adopted the report, with certain minor amendments.

709. What I want to get at are the main points in that report adopted by the Town Council. Am I right in saying that this was the first point, that the water supply should be in the hands of some public body supplying the whole of the Rand, and that the town supply should be in the hands of the Municipality?—Yes, that was the principle laid down by the Town Council.

710. The next that water should be charged for by rate and not by meter?—Yes, that was also a decision of the Council.

711. That gardens in the town should be encouraged?—Yes. That is very desirable, I think.

712. That it is the intention of the Council to establish public baths, washhouses and slaughter-houses?—Yes.

713. Under the present circumstances of the town, what was the minimum daily supply of water that the Council considered it should have?—Fifty gallons per head per diem for the white population, and 30 gallons for natives. That is the minimum.

714. The minimum under present circumstances?—Yes, with the object of increasing it by ten gallons, if possible.

715. (*The Chairman*). Ten gallons all round?—Yes.

716. (*Mr. Lance.*) That is to say that the present 50 gallons for whites and 30 gallons for natives should, if possible, be increased to 60 and 40 gallons?—Yes

717. Did the Council take into consideration a possible increase of population?—They did, and they estimated that in the next five years the white population should increase to 200,000, and the natives to 80,000.

718. Did you arrive at a basis of the present normal population?—Yes, we did. The Committee went fully into that matter, and with the assistance of the old census and the number of buildings in the town, we fixed the normal population—that is, the normal population before the war—at 100,000 whites and 60,000 blacks.

719. Now this population you estimate will in five years probably increase to 200,000 white and 80,000 blacks?—Yes.

720. So that you reckon that within about five years approximately 300,000 persons should be provided for?—Yes, that was the estimate of the Committee.

721. And you also found from the statistics before you that the quantity of water required per head increased with the increase of population?—That was so according to the statistics we had.

722. (*The Chairman.*) You mean increased out of proportion?—In proportion with the increase of population there was an increase in the amount of water consumed per head per diem.

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723. (*Mr. Lance.*) So I think you allowed for a further increase of 10 gallons per head when you came to the 300,000 population?—Yes, that was the decision the Committee came to.

724. (*The Chairman.*) Mr. Pistorius, you stated that you considered that while a public body should provide the water the Municipality should retain in its own hands the distribution?—No, we want that for the town to be in the hands of the Municipality entirely.

725. Exactly. So that seems to imply that in the mind of the Town Council there is some scheme of this sort, that there should be a public body conveying the water along the trunk line, from which the Town Council and any other municipalities, and the mines, or groups of mines, should severally draw the water by meter, the public body dealing with the Town Council, the mines, or the other municipalities as wholesale consumers, and not troubling with what happened to the water after it had left the trunk line?—That would be so if the water was drawn from a source that would tap all these places.

726. The terms of the reference to the Commission imply that it should prepare a scheme to supply water to the Rand, and if the Town Council wish to retain in their own hands the distribution, it seems to me to follow, as a necessary consequence, that this public board would deal with the Town Council as a wholesale consumer, and have nothing to do with what happened to the water?—Certainly, the Town Council or Corporation would deal with the water from a certain point.

727. So that you would be a wholesale consumer, and you would draw the water by meter from us, and pay for whatever you took?—The public body would deliver to us from a certain point, and after that the water would be entirely in the hands of the municipality of the district.

728. Similarly, the mines would take a supply and retail it to their customers?—Exactly.

729. Then, of course, under a scheme of that kind, the board would have to fix a price per thousand—which would as nearly as possible cover the cost of depreciation, working expenses, and redemption—which it would charge its wholesale customers; and I presume if any balance were over it would be distributed *pro rata* at the end of the year among the consumers?—You mean that the profits arising out of a public scheme at a certain charge for the water should be returned to the consumers? That is a detail in the working of the general scheme.

730. Primarily, your idea would be that the board would fix the price which you believed would cover all which had to be done?—Exactly so.

731. You can hardly prevent having a surplus, if you are prudent. That would be a matter of detail?—Yes.

732. Now, of course, we must accept the figures of the Town Council as their requirements. We cannot challenge them, and it will be our duty, I presume, to frame a scheme which would supply what you want. But I presume that the Council agree that it imposes on them an obligation to guarantee to take that amount of water?—I do not think there will be any difficulty in that. Mr. H. F. E. Pistorius. December 16, 1901.

733. You follow me?—We estimate that for the present normal population we shall require between six and seven million gallons, and that I see agrees very much with the figures already laid before the Commission. Mr. Willcocks also estimates that for the present population we shall require between six and seven million gallons per diem.

734. Yes. I believe your engineer is going to follow you?—Yes; and he has got statistics.

735. We may take it that any evidence he submits to us has been previously submitted to you?—Yes; the whole of the suggestions he will present to you have been presented to the Water Committee already.

736. It comes to this, that he has discussed this question with you?—Yes; being an engineer he has got all these matters at his finger ends.

737. You estimate that in five years your population is going to be something like 300,000. Now, having regard to the time that must elapse before this water scheme is elaborated, by us or by anybody else, it is pretty obvious that we must begin from the first to supply the amount you will require at the end of the five years?—No; it does not follow. You would make preparations for the increase in your machinery, but plant to cope with the full supply would not be put in at first.

738. But recollect; according to Mr Goch's evidence, it would have taken him from two to three years to lay on the amount of water he was prepared to sell. It is not likely to take us much less than the same time, and it would hardly do for us to lay on the water and then, within twelve months have to duplicate the plant. What I mean is that by the time the work is completed we shall be drawing near to your five years' limit, so that I think that before the time of beginning to bring in the water the amount of the supply ought to be fixed?—That is quite an engineering question, but I do not think it ought to take more than two years.

739. We shall take two years. Suppose we say three years altogether?—It depends on when a commencement is made.

740. Say three years. How much water ought we to provide immediately at the end of three years without having to supplement the supply in twelve months' time. Do you follow me?—Yes, I follow you.

741. It follows that we ought almost to have an estimate from you as to what we shall have to supply in three years' time?—Yes, that is so. Taking our present condition, where we have a very high-priced water, we can still manage; and I daresay we could at the end of three years manage with a similar allowance.

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742. Do you think it would be true economy to lay down a plant calculated to supply what you will want in three years time with a knowledge that in two years after that you have got to supply a very much larger quantity?—No, I do not think it would be.

743. It would partially depend on whether the main line of supply would consist of one set of pipes or two?—Exactly. If the water had to be taken from different sources, the main pipes would not be similar. If it all had to come from one source, you would have a large pipe laid down at once.

744. But even then two pipes might come along the same track?—Yes; but I am satisfied that if you take the water from the Vaal River and from another source you will have two lines of mains, and it might not be necessary to have both these completed at the same time.

745. You mean to supply from one source to begin with?—Yes.

746. Even then you are confronted with the question of the pipe line along the Rand?—You are, and for that reason provision should be made in the first instance for conveying a larger supply.

747. So that even if you did not commence pumping water it would still be economy to lay down a pipe line to meet the requirements at the end of five years?—Certainly.

748. Of course, as we just said, the Town Council being liable for the amount they ask us to supply, I suppose you have considered the question from a financial point of view, and are satisfied the town would be able to support this charge for 19 million gallons per diem?—It is 15 million gallons per diem, the maximum amount that is estimated for.

749. Nineteen million gallons are proposed. Perhaps I am anticipating another witness. Yes, 19,200,000. My question, however, is general—whether the Town Council had considered the matter from a financial point of view?—The Town Council are bearing in view that a general scheme of that kind will lay down water at a very much reduced price, compared with the prices paid in the past, and the consequences are that with a very much increased consumption the town will not be taxed to a very much larger extent than they are at the present time.

750. I am going to suggest to another witness that it possibly means three-quarters of a million per annum. You think the town can stand that charge?—Yes, with the increased jurisdiction the town would be able to stand that very well.

751. These figures that you give us for the expansion of the population are based on the present municipal area?—No. The present municipal area will hardly hold the population we mention, and we will have to go beyond the present municipal limits.

752. It is not a matter which comes directly before the Council, but have you any information or the means of getting information of the probable population within the next five years along the Rand outside the municipal area?—I don't think the Council have information on the subject.

753. Has the Council formed any view as to what policy should be agreed upon in case of a shortage of the water at the disposal of the Public Board for distribution between the mines and the town?—I do not think the Council has come to any decision, but if there is a shortage you will have to do with a smaller quantity.

754. It is quite conceivable that the demands might be so great that they could not be met?—If there is more than one large body to be provided the quantity available must be divided in proportion to their requirements.

755. So that you would perhaps consider it fair in such a case if shortage was distributed *pro rata* on the previous consumption of the town?—I do not think there are any statistics which can be argued upon.

756. Is this a question of statistics?—I think it is so far as the consumption of water is concerned.

757. Taking it from this point of view, the mines may say they will be reluctant to come into a scheme of this kind when they do not know where they will stand in the event of shortage?—I think the mines in the past have been pretty well able to look after themselves, and in entering this scheme they will be able to satisfy themselves how they will stand.

758. Yes, possibly. The Council has not considered the question?—No.

759. I do not know that it would not facilitate matters if a definite basis of some kind were agreed upon beforehand by the public body, and it occurs to me that the fairest basis would be the previous rate of consumption that any diminution should be in proportion to the amount previously consumed by each section. It is probably a point which the Council will consider, and if they have any suggestions to make they will lay them before the Commission?—Yes.

760. You see my point—that there will be no trouble if there is a previous agreement among the consumers on the point?—The idea of the Council is to get a full supply for the inhabitants of the town.

761. (*Mr. Brakhan.*) You mention that the white population had been computed at 100,000 inhabitants?—Yes.

762. You might be good enough to tell me what this includes?—The three mile area.

763. From Market Square?—Yes.

764. Does it include the mines?—Yes, taking in the mines within the three mile radius.

765. What was the consumption in the year 1899?—I have not any idea.

766. But would it not be well to compile some figures?

(*Mr. Thomson.*) It was just over 311,299,000 gallons.

(*Mr. Brakhan.*) I mean the amount per day.

(*Mr. Thomson.*) That is a million gallons per day.

767. (*Mr. Brakhan.*) Were there any outside sources of supply?—There was a very large area of the Municipality that was not supplied by the Waterworks Company at all. A good deal of Fordsburg and Braamfontein was not supplied.

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768. Would it not be well to obtain some data as to the amount of water supplied in the past and the amount that will be required later?—I do not think it will help you at all. The very fact of the water being at such a high price restricts the use of the water, and I do not think these figures would give you any basis to work on. If the water were not so high in price statistics might help you. You have seen from the evidence of Mr. Goch that he could supply water at half-a-crown, and we are practically paying 9s. or 10s.; and therefore the statistics we could get would not help you because the people have not had the opportunity of availing themselves of cheap and plentiful water.

769. That is one element?—It is a very strong element, I think. If you had water at 2s. 6d. instead of 10s. or 9s. you would see a difference in consumption.

770. Of course, it would increase. I only wanted to ask whether data had been collected?—It has not been possible to collect any data on this point that would be of any advantage.

771. (*Mr. St. John Carr.*) There is just one thing I would like to bring out. The Chairman asked you as to how the division of the water would take place in the event of a shortage of the general supply, and how you would apportion the water in this diminished ratio. Do you not think it would be fair, supposing the general water supply were reduced by 10 per cent., that you should reduce the supply to various wholesale consumers in the same ratio?—Yes; that would be fair, I think. Reduce the supply to the wholesale consumers by the percentage that was short.

772. (*Mr. Rouliot.*) Mr. Pistorius, you told us that the normal population is 100,000 whites and 60,000 natives. That is within the three miles radius from Market Square and embracing a certain number of mines?—Yes.

773. Can you tell me what area you have calculated to provide for the increase of the population to 300,000?—It naturally follows that the town must extend somewhere It must extend south and north of the Reef, and we expect the town will go out four or five miles instead of extending three.

774. What basis did you take to estimate that the future population of the town would be 300,000?—We expect a very large influx of population as soon as normal conditions are resumed, and the area they will occupy will be north and south of the Reef as far as they can get dwelling sites.

775. Is it a four mile radius, a five mile radius, or a ten mile radius from the Market Square?—It is between four and five miles.

776. You estimate that in a radius of four or five miles from Market Square, embracing east, west, north and south, you will in five years' time have 300,000 people settled?—Yes.

777. Therefore, all the mines which fall within that radius are included in your calculations?—Yes, they are, naturally.

778. Among these 300,000 persons who will inhabit that radius can you give me any idea what proportion would be residing on what we call to-day the mining area?—No, we have not got an estimate of that at all.

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779. You see this is a rather important point to settle. The Town Council states requirements amounting to 19 million gallons per day to provide for 300,000 people residing within this radius of five miles from Market Square. Now you will have the Chamber of Mines coming forward and stating requirements for all their mines and providing for the domestic wants of the people on their mines, which will cover also a portion of what you have included?—It is only a matter of reduction to obviate the same requirements being stated twice. The mines are not so thickly peopled as the town and the out-lying parts of the town will be, and it is very easy to deduct from the total mentioned by the Town Council the proportion which will be necessary for the people on the mines.

780. Then on the other hand, I would ask you whether you can tell me what number of this 300,000 was provided for as residing on the mines?—According to the figures we took into consideration, the proportion residing on the mines is very small compared with the same area in the town.

781. So practically in your opinion the mining population which is provided for in the requirements which you have stated is a very small amount?—Yes, it is a very small amount compared with the same area in the town.

782. Now it has been indicated that the scheme will probably be that the water will be brought here through a trunk-pipe out of which the Municipality of Johannesburg on the one hand, and the mines or groups of mines and the other municipalities on the other hand, will draw their water, and it has been foreshadowed that the Water Board will naturally ask for a guarantee for a minimum consumption. It is clear that, if the Water Commission bring forward a certain scheme based on the requirements of the town and district, it will be necessary, in order to provide the machinery and capital required to bring here the quantity of water stated, that they should get some guarantee that the amount stipulated for will be taken, so that the water scheme becomes a feasible one. Therefore I take it that the Town Council will guarantee to take a certain quantity, the Chamber of Mines, acting on behalf of the mining companies, will guarantee a certain quantity, and the other municipalities will guarantee a certain quantity. Now take the case of the mines which you have included within the five mile radius. They are going to be provided for as included in the minimum amount of water which the Chamber of Mines will guarantee to take. They will be called upon by the Chamber of Mines to pay a proportionate share of the guarantee of the Chamber, and at the same time they will be called upon by the Town Council to pay a water tax to cover

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the cost of the guarantee which the Council has given. Don't you see that these unfortunate mines which fall within the five mile radius will have to pay twice over for water?—No. We have made no estimate of the water the mines are going to consume as mines. The mines will pay the public board for the water they use for mining purposes, but the mine employees will come under the same category as the inhabitants of the town.

783. There will not be two schemes. In their guarantee the mines will state the quantity of water they will require for the mining operations, and they will make allowance for the water required by their employees for domestic purposes. If there is no connection with the Municipal main to supply the residents on the mines they will not be called upon to pay the water rate?—That is a matter of arrangement.

784. If they fall within your jurisdiction you will apply your rate to all?—At the same time you cannot expect to be paid for a service you do not render, and if the mines are not connected with the Municipal supply how can you expect the employees to pay?

785. You do not expect these unfortunate mines to pay twice?—No, certainly not. That on the face of it speaks for itself.

786. (*Mr. Kitzinger.*) You go on the basis that in five years the white population of the Rand will double?—Yes.

787. The question has been asked. "How?" and I think the only answer you made was that the population would increase. But has the Town Council any data to go upon in estimating such an increase of population?—Taking the increase in the past, we expect that we are well within the limit when normal conditions prevail. The population increased in the past in a greater ratio.

788. It depends on the year you take. I do not think the increase between 1894 and 1899 is an increase which would warrant the increase you estimate from now till 1906.—Why not?

789. I go by the small increase of the mining companies.—I do not think that is a fair basis at all.

790. What do you attribute the increase to if it is not to the mining industry?—That is right enough, but the increase of the population generally will be larger than the increase of the number of employees on the mines would seem to warrant.

791. Where are they going to live?—They must cultivate the land and use water.

792. It strikes me that the municipal expansion which you expect is too large.—I think it is a very fair increase.

793. Another point is this. The Johannesburg Waterworks Company supplied Johannesburg—the town as well as the Town Council for street watering—during the last twelve months before the war, viz., the year ending 30th June, 1899, with 337 million gallons, equal to about 900,000 gallons a day, including that used in street watering. Now, don't you think that the increased consumption per head per day that you propose to provide for is out of proportion?—No. Take Maritzburg, which is not a mining town at all. The engineer will tell you that the amount of water consumed per head per diem at Maritzburg is 54 gallons of the whole population, and that it is 58 gallons per head per diem in Durban. It cannot be said that there are many industrial institutions in these towns which take up a large quantity of water. It is all residential property and they are consuming from 54 to 59 gallons, and they do not seem to have any surplus.

794. *Mr. Kitzinger* wanted to know on what basis the Council arrived at such a large increase in the amount of water to be supplied per head of the population?—May I ask you how Berlin got on with 16 gallons per head per day?

795. It is a very clean town. Have you ever been there?—Yes, there is plenty of sand there.

796. I do not see why you should go from 10 gallons per head to 40 gallons?—As I have already pointed out to the Commission in the past the high price has prevented a large quantity being used.

797. Dosen't it strike you that a large proportion of the population here would not use the water if it were given to them for nothing, and that there is a fair proportion who would use it independent of the charge?—You must bear in mind that the Town Council has a duty to the public to make them cleanly, and the more water that is used the less the death-rate.

798. I quite approve of the object. I only speak of the abnormal proportions of the proposed supply?—They are not abnormal when we point out to you that the average in Maritzburg and Durban is 54 and 58 gallons respectively. Our estimate is not an extreme one. You must remember the climate we are living in.

799. It has been the same during the last ten years. I am only contrasting your figures with those of the past. I think the figures for the future put down by the Town Council are very high.—I do not think so.

800. (*The Chairman.*) Is there not one point that you have not made—that whatever you are willing to pay for the water in the past you could not get it?—There has been a scarcity, and we have suffered in the past, but the supply has been better during the last year or two.

801. The Waterworks Company could not go beyond the three million gallons per day?—No. I do not think they could have doubled the supply until the Zuurbekom scheme was started.

(*Mr. Kitzinger.*) I can see no justification for your figures.

(*Witness.*) Then we must agree to differ.

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Dr. W. T. F. DAVIES, called and examined:

802. (*Mr. Lance.*) You are a medical practitioner in Johannesburg?—Yes.

803. And have resided here for several years past?—Yes.

804. And you are a member of the Town Council?—Yes..

805. Have you carefully considered this question of the water supply for the inhabitants of the town?—I have gone into it chiefly from a medical point of view.

806. Now, can you tell us what your opinion is with regard to the requirements for domestic and trade purposes?—I think a fairly liberal allowance would be 30 gallons per head per day.

807. Can you give us the details as to how you arrived at that?—I should reckon for drinking and cooking, 1 gallon; domestic and washing purposes, 6 gallons; water-closets 6 gallons; waste on water-closets—because there is always a certain amount of waste —2 gallons; personal washing, 5 gallons; baths, 5 gallons; trade purposes, about 5 gallons.

808. That makes up the total of 30 gallons per head per diem for domestic purposes. Now there are some other points to be considered, are there not?—Yes.

809. Can you mention them?—I should say that you want the balance of the water for streets and gardens. I understand that the acreage of the streets is a very large one, and that, not only on account of the acreage but also on account of the dryness of the atmosphere, they require very much more water, and more frequent watering than in English towns. Then there is a very much larger proportion of animals, horses and carriages in this place than in the ordinary normal town, which would necessitate more water. Then, again, there are the public wants, such as wash-houses and public baths, which will take up a considerable amount of water; and I reckon that the extra amount over the 30 gallons per head which I have mentioned would be between 15 and 20 gallons per head. making a total of roughly from 45 to 50 gallons per head of the population.

810. You consider that the minimum requirements on the present basis?—I consider that a very fair allowance.

811. Now, do you know that statistics have shown that as the population increases the amount of water per head increases? Is that correct?—I believe that is generally stated as a fact.

812. Are there any differences to be pointed out in the habits of the people here and in an English town in regard to the requirements of water?—I should say, speaking generally, that they require a good deal more water here. They partly require more because it is a very different climate. I do not think you can compare Johannesburg with any English town in deciding on a basis for water supply. The whole conditions of life are different. The people, taking them all round, are of a better class, and a very much more cleanly people, and I think they use more water. If they do not use more water they certainly ought to do.

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813. I may take it that you approve of the principle of supplying water by rate rather than by meter?—Yes, I rather think I do. I do not know sufficient to give you a decided answer, but my own impression is that it is a better method of supplying it, because you are more likely to get a sufficiency of water used.

814. And shouldn't it be laid down as a principle that there should be enough water for people to waste it?—I would put it in this way, that I do not think the population is having enough water unless water is wasted.

815. And it is of first importance to the town, is it not, that the water supply should be constant?—Yes, certainly; not intermittent.

816. And that it should be sufficiently pure not to need filtration?—Certainly.

817. Now, while on this subject, can you state what, from your point of view, are the relative merits of water from the dolomite and surface water? We have had a little evidence on that point this morning?—Speaking *prima facie*, dolomite water, which comes from underground, is a great deal purer. If you get surface water from an area which cannot be contaminated I regard it as good as any other from a health point of view, but the area must be protected so as to do away with any risk of contamination.

818. Is the presence of lime injurious from a health point of view?—Not a certain amount of it.

819. Then, to sum up, you think that a water supply should be unfailing, that it should be plentiful, that it should be constant, and that it should be cheap?—Yes, I think these are the four principal points.

820. Just a word on another point in regard to Mr. Willcocks' evidence. Mr. Willcocks referred to the question of a sewerage scheme for Johannesburg, pointing out that in his view such was not necessary. Would you give us your opinion?—I think Mr. Wilcocks is entirely wrong, and I should like to say here what I have said before, that I consider Mr. Willcocks in giving evidence on a matter of that kind was quite unjustified in his remarks, because he was not a sanitary expert, and, as far as I remember reading his evidence, he did not give an answer to the question asked. He said he did not think a sewerage scheme for Johannesburg was advisable. I do not think he has any special experience of sewerage schemes which would justify him in giving an opinion which is contrary to the generally accepted opinion of ordinary experts now-a-days.

821. Then we may take it that you consider it essential to the health of Johannesburg that we should have a sewerage scheme?—Certainly.

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822. Mr. Willcocks referred to the danger from soakage of the sewage. Can you say anything about that?—As far as I know the only water supplies which are supposed to be at all feasible for Johannesburg come from many miles to the west of the town—I believe I am right in saying that—and the natural outfall of any sewerage scheme would, I think, be to the east. And the distance between the two points would, I think, be between fifteen and thirty miles, and it would be ridiculous to talk of contamination at that distance.

823. You consider that the distance of twenty or thirty miles precludes the possibility of contamination?—Yes. Besides that, if there was any danger of contamination the sewage could be treated in such a way that if some of the effluent found its way into the water supply it would do no harm.

824. (*Mr. Thomson.*) You base these figures on the assumption that a sewerage scheme is in operation?—Absolutely.

825. In the meantime when there is no such scheme the requirements would be less?—I would not knock off more than seven gallons.

826. You think it would not be advisable to have a waste of water in the streets until you have a sewerage scheme?—No. I think there is such a thing as too much water being used until you have the means of carrying it off.

827. Until you have the means of carrying off the waste water?—I think it would be advisable to correct waste.

828. I would like you to define what you mean by waste?—The present waste water is carried away by slop buckets. If you increased the consumption from 10 to 50 gallons it would be impossible to carry off the waste.

829. And it would soak into the streets?—Yes.

830. What is the amount of water per head which would be injurious if it was not carried away by sewerage?—I cannot say.

831. Would you say that 20 gallons per head would be injurious if it were not carried off?—No, I don't—you must not make too much of this point—for this reason, that if you have a large amount of water you lessen the strength of the slops and filth in solution, which, therefore, will not do so much harm as the concentrated filth that you have in the town at the present time.

832. With a supply of 10 gallons per head?—Yes.

833. The sewerage being carried to the east and the water coming from the west, you would have a difference, you say, of 25 miles?—I speak without the book.

834. Will you tell us the points you have in your mind?—I have a very hazy idea where these dolomite formations at Wonderfontein are.

835. Did you have Wonderfontein in your mind?—No, I did not. I believe Wonderfontein is much further.

836. (*The Chairman.*) Dr. Davies, the answer you gave to Mr. Thomson seems rather to call for a revision of your figures. You gave us certain details and you arrived at 50 gallons per head as the amount of water required. Would you say that it would be unsafe to use any portion of that until you have connected the town with a drainage or sewerage scheme or both?—No, sir. What I say is that I think you can knock off 6 gallons for water closets and 2 gallons for waste on W.C.'s. I think you could do with a certain amount less for personal washing and baths.

837. That all depends on the individual, and is not under our control?—No. But at the present moment there are certainly not 10 gallons used on personal ablutions and baths.

838. I am only going on the one point of its not being carried away. You would at present limit the amount used on baths and street watering?—No.

839. You have no control over them of course?—No, but they control themselves. One of the reasons why people don't use water more freely here is because they cannot deal with it. In the suburbs which do not contain so many houses the difficulty is not so great because they can run the waste water out into the gardens; but here in town they cannot do this, and they cannot flood the streets. Consequently the present state of affairs is detrimental to their using as much water as they would otherwise.

840. What would be the effect of that?—A reduction of 13 gallons per day.

841. You only allowed ten?—There would be the eight gallons put down for W.C.'s and five gallons of the amount for baths. That makes 13 gallons.

842. Until sewerage and drainage are provided we can take off 13 gallons from your amount?—Yes, for the absolute wants of the people.

843. I thought you stated 50 gallons as a minimum?—That question was asked me whether that would be a minimum, and I answered that it would be a very fair supply.

844. I take it you would not go so far from a health point of view as to say that 70 gallons are necessary?—I give you my opinion purely from a medical point of view, and I am stating what I consider a fair amount. But the more water the town uses the better.

845. And perhaps we may take it as a reasonable assumption that the town will not consume the outside limit which has been suggested by others?—I have not heard the amounts which they have suggested.

846. I understood you to say that we cannot expect the town to use the amount which it would otherwise use until we have drainage and sewerage?—No.

847. The question has been raised of rate *versus* meter. Have you considered the Capetown system of rate plus a minimum; that is to say, whatever you use you have to pay a minimum rate, and after that pay

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by meter. Don't you think that sufficient water, from a health point of view, would be used under such a system, and that it would restrain the extravagance of people who would otherwise keep their taps running all day? Don't you think there is something to be said for the combination?—I think the system is very good, provided the minimum is large enough.

848. Exactly. Don't you think it would restrain the desire of people to get the most for their money even though they waste it?—Certainly. That, however, is not the point I meant.

849 You think this system would be sufficiently safe from the health point of view?—I think so.

850. I think you said that it was an absolute necessity that the water should be so pure that it would not require filtration?—I said it was advisable.

851. But you hardly expect to always get water so pure?—No.

852. On the question of dolomite *versus* surface water, I take it you are drinking dolomite water in town?—Yes. I take it you are referring to what I said with reference to surface water from a catchment area.

853. I thought somebody put the question as to whether dolomite water was good to drink, the suggestion being that surface water was better?—I was referring to surface water from a catchment area and not from rivers.

854. I take it that the dolomite water that you are drinking in Johannesburg to-day is good and that you have no fault to find with it?—Oh, no, it is very good.

855. And the salts it contains have no injurious effects on the population?—No.

856. (*Mr. Rouliot.*) You are in favour of a sewerage scheme.—Decidedly.

857. Is that only on the point of principle, because it is generally held that sewerage is desirable; you have not gone into the question from an engineering point of view to see if it is feasible?—I do not think that is a question to be considered, because a sewerage scheme can be introduced in any town provided the work is properly conducted.

958. You have not thought out what the cost will be?—No.

959. And have you thought what you will do with the product of sewage when it is delivered?—There are two methods of dealing with the sewage—either by means of sewage farms or by subjecting it to treatment so as to render the effluent pure and allow it to run into the ordinary streams in the country.

860. There are other means which have come into use lately, such as the Liernur system?—Yes.

861. If any such system were adopted here would the quantity of water required be less than you have stated?—A little, but not very much. The amount of water that is used for water-closets is not so great as to make such a large amount of difference. There is a very much larger amount of water being used for other purposes in a town of this size, and it seems to me ridiculous to cavil over five or ten gallons per head per diem. One has an opportunity here to make this one of the healthiest towns in the world by means of a good sanitation scheme and a good water scheme, and to go into the matter with any niggardly ideas, such as trying to do with as small a quantity of water as possible for the use of the community is a great mistake.

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862. I have heard it said—of course I am no expert—that opening up new ground for building sewers may introduce fresh germs of disease not known before?—I do not know of any such cases.

863. (*Mr. St. John Carr.*) There is one thing I would like to ask you—I think it has been brought out generally—and that is whether you do not think that there would be a greater chance for an improvement in the health of the town by the adoption of a large supply such as you suggest than by having the smaller quantity which you mention?—Certainly.

864. (*Mr. Quinn.*) Were you a member of the Transvaal Medical Society in 1896?—I have been trying to find out. I have been a member of the Society—yes.

865. Were you a party to this resolution?—I was trying to find out, but I cannot tell you.

866. The Transvaal Medical Society then stated that they considered 40 gallons per head necessary for the inhabitants of Johannesburg.—I have a sort of idea I was either in gaol or in England at the time the resolution was passed.

867. I don't think you were in gaol then—at least not here. Do you agree with that statement, Doctor?—I do not know if they had any thought of a sewerage scheme. They passed a resolution, and in that resolution stated 40 gallons per head as a minimum quantity. I think they based that on the average amount used in English towns, and that was considered by the authorities of that day a liberal allowance.

868. That met with your approval?—For England, yes.

869. For this place—I say that with a sewerage scheme you would do better with more than 40 gallons.

870. Apart from that, they recommended 40 gallons?—Yes.

The Commission then adjourned.

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WITWATERSRAND WATER SUPPLY COMMISSION.

MINUTES OF EVIDENCE.

FOURTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

MONDAY, 30TH DECEMBER, 1901.

Present:

G. V. FIDDES, ESQ., C.B., SECRETARY TO THE TRANSVAAL ADMINISTRATION (CHAIRMAN).

A. BRAKHAN, ESQ.,
B. KITZINGER, ESQ.,
W. McCALLUM, ESQ.,
W. ST. JOHN CARR, ESQ.,
J. W. QUINN, ESQ.,
G. ROULIOT, ESQ.,

G. CRAIG SELLAR, ESQ., SECRETARY.

JOHANNESBURG TOWN COUNCIL (*Continued*).

(*The Chairman.*) Mr. Lance, we will take your evidence first.
(*Mr. Lance.*) Very well, I will call Mr. Andrews.

Mr. GEORGE SAMUEL BURT ANDREWS, called and examined:

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871. (*Mr. Lance.*) You are the acting Town Engineer?—Yes. You have resided in Johannesburg for a considerable time?—For eleven years.

872. And during portion of that time you have been engaged in the Town Engineer's Office?—Yes; eight years.

873. Under instructions of the Town Council, you have considered the position in regard to the requirements of Johannesburg in the matter of water?—Yes.

874. You have gone very carefully into the matter?—Very carefully.

875. And in doing so you have borne in mind certain lines of policy which have been laid down by the Council?—Exactly.

876. These are, I think, that the future water supply of the town should be by means of a public body, the distribution being in the hands of the Town Council?—Yes.

877. That water should be supplied by rate rather than by meter?—Yes.

878. And that the use of gardens should be encouraged?—Yes.

879. And that the Council will supply public baths, wash-houses, and slaughter-houses, and that there is a possibility of a water borne sewerage scheme being adopted?—That is so.

880. All these you have considered?—Yes.

881. You have made enquiries as to the quantity of water taken in different towns in South Africa, have you not?—Yes, I have.

882. Now, will you tell us what you find is the consumption in Pretoria per head of the population?—In Pretoria the consumption per inhabitant is 64 gallons and for gardens 80 gallons.

883. Will you explain how the supply for gardens comes to be mentioned separately in Pretoria?—It is mentioned separately because we want to go on the same principle in Johannesburg, to encourage the use of water for gardens

884. Yes, but they have a separate distribution in Pretoria for gardens, have they not?—Yes, they have a separate distribution.

885. That is how you are able to get the figures separately?—Yes.

886. So that in Pretoria you have 64 gallons per head for ordinary purposes and 80 gallons per head for gardens?—Yes, making a total of 144 gallons.

887. In Durban what do you find?—In Durban the daily consumption is from 54 to 58 gallons per head.

888. In Maritzburg?—And in Maritzburg 42 gallons per head.

889. In Capetown?—Capetown 29 and a half gallons.

890. Bloemfontein?—Seventeen gallons.

891. Port Elizabeth?—Thirteen gallons.

892. East London?—Thirteen and a half gallons. But the reason the supply per head is so small is on account of the scarcity of water in those particular towns last mentioned.

893. You know that there is a special scarcity of water in Port Elizabeth and East London?—Yes.

894. With regard to Bloemfontein being somewhat low can you give any explanation?—So far as I know Bloemfontein has only quite lately gone in for a water supply.

895. And the price there is somewhat high?—The price is very high, I believe.

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896. What is the price at Bloemfontein?—5/- per 1,000 gallons.

897. That, for a population like Bloemfontein, is a high charge?—Yes, it is a high charge.

898. You have also obtained some statistics, have you not, as to the average consumption of water in large American cities?—Yes, a large number of statistics as to the amount of water used per capita in the United States.

899. (*Mr. Lance.*) I put in this statement* which has been prepared by Mr. Andrews.

(*To witness.*) I think you deal, in this statement, with all cities in the United States with a population of over 60,000?—Yes, that is so.

900. And the average for the number of cities given is 103 United States gallons, or 86 Imperial gallons per head?—That is the average.

901. But the figures range in some cases a good deal higher?—Yes, in one case the consumption is 238 gallons per head. In Chicago it is 140 gallons.

902. Now, in these statistics, you also show the population per house connection, that is per leading of these American towns?—Yes.

903. And in cases where you find a large number per leading there the consumption of water per head is low?—Yes, compared with the others.

904. And *vice versa?*—And *vice versa.*

905. That goes to show, does it not, that where the population is of the better class, with only a few to each leading, there the consumption of water per head is high?—Yes.

906. Then you also obtained some statistics as to the way the number of gallons per head increases with the increase of population?—Yes.

907. And you have made some extracts from Mr. Fanning's work?—Yes. Mr. Fanning, in his treatise on hydraulics and water engineering says: "In the New England towns and cities the daily consumption and waste of water, according to population, is approximately as follows: Places of 10,000 population, 35 to 45 U.S. gallons per capita; places of 20,000 population, 45 to 50 U.S. gallons per capita; places of 30,000 population, 45 to 65 U.S. gallons per capita; places of 50,000 population, 55 to 75 U.S. gallons per capita; places of 75,000 and upwards, 80 to 100 U.S. gallons per capita."

908. You have also got some statistics† from Mr. Fanning as to the increase in the consumption of water consequent on the legitimate use of water in different towns?—Yes, I have a list here. For instance, in Boston, in 1866, they were using 55 gallons, and this increased in 1890 to 105 gallons. Here is a remarkable case in Cleveland where they commenced with 8 gallons in 1857 which increased to 106 gallons in 1890.

909. Then you have also obtained some *statistics on the rainfall in Johannesburg from 1889 to 1901?—Yes.

910. And †statistics about evaporation?—Yes. The average rainfall per annum in Johannesburg is about 29 inches and the evaporation about 62 inches.

911. (*The Chairman.*) Sixty-two inches?—62 inches.

912. (*Mr. Lance.*) Would you explain what that evaporation of 62 inches means?—The evaporation gauge was placed on a sheet of water with a varying depth up to 12 feet. I have no data as to the evaporation from the earth.

913. It is evaporation from a sheet of water about 12 feet deep and you found that 62 inches evaporated in a year?—Exactly.

914. It is very nearly 50 per cent. of your total quantity of water, but not quite?—Yes.

915. The white population of Johannesburg, I believe, is composed largely of people of the better class?—Yes, I consider it is.

916. Can you give us any idea of the number per leading at present?—The number of inhabitants per leading in Johannesburg?

917. Yes.—I believe that is given in the evidence contained in the Concessions Commission's Report. The number of leadings in Johannesburg is given as 4,893, and if you take 10 persons to a leading, which I think is a rather high number, it gives 25¼ gallons per head per day.

918. That is what is being supplied at present by the Water Works Company?—Yes. That is taking it on a maximum basis of 1¼ million gallons per day, because the amount given for town consumption and street watering is 337,343,772, and if you divide that by 365 it gives 924,229 gallons per day, but that does not represent the maximum quantity consumed.

919. You have given the number of leadings and the quantity of water supplied by the Water Works Company. Are there any districts which the Water Works Company does not supply?—Yes, several.

920. Will you just mention them?—There is Fordsburg for instance, that is not being supplied with water. They have just lately put a main down there which does not come into these calculations. Then there are the Locations, Burghersdorp, and, I cannot say for certain but I believe, a large proportion of Braamfontein is supplied by wells.

921. Park Town?—Park Town is not supplied by the Company, nor any of the townships outside the present jurisdiction of the Council, such as La Rochelle, Turffontein, Rosettenville, and Booysens.

922. So that if we take the present normal population at 100,000 it is not fair to divide that into the quantity of water supplied by the Water Works Company and say the result is the average consump-

* See Appendix F. 1.

† See Appendix F. 2.

* See Appendix F. 3.

† See Appendix F. 4.

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tion per head?—No, it is not. While we are on that subject I should like to mention that according to the report of the Water Works Engineer, in 1894, the maximum quantity of water used was 884,00 gallons per day, or 29½ gallons per head of the population.

923. That you have found from the records of the town office?—It is from a paper read by the Engineer to the South African Society of Engineers and Architects.

924. By the Water Works Engineer?—By the Water Works Engineer.

925. (*The Chairman.*) You mean of the population actually supplied?—Yes, Sir, not on the whole population.

926. (*Mr. Lance.*) You have referred to the class of population here as indicating a larger requirement per head than the average?—Yes.

927. There are also other reasons, I think, which tend to a large supply per head of the population being necessary in Johannesburg?—Yes. Of course, one of the chief reasons is on account of the dryness of the atmosphere. It is a very dry climate, and, naturally, the requirements for street watering are very much larger than in any ordinary town.

928. And a large proportion of the population consists of adult males?—Yes, I should say so.

929. That is to say, there is a smaller proportion of children than in other towns?—Yes.

930. Then there is a large proportion of animals?—Yes. According to the census taken in 1896 there were over 11,242 horses, mules and asses, and 2,500 horned cattle, and I have based my figures on those returns.

931. So the assumption is that the number of animals in Johannesburg is in excess of those in an average town?—I should certainly think so.

932. And the number of carriages and vehicles is also larger?—Yes, I think the proportion here is greater than in other towns.

933. And these would require water?—Yes, for washing purposes.

934. Would you tell us what you estimate the requirements at under present conditions per head?—At present I think it would be wise to provide 60 gallons per head per day for the white population, and 40 gallons per head for the Natives.

935. And with a view to future requirements, should those figures be increased?—Yes, I think, after taking into consideration the statistics which have been brought forward, we ought to allow at least 10 gallons extra over and above these totals, say within the next five years.

936. Will you tell us what you consider to be required for domestic purposes?—For domestic purposes 30 gallons, and that is borne out by the medical witness.

937. Can you give us some details of that?—These details are given by the medical evidence.

938. You have seen the evidence given by Dr. Davies?—Yes, and I agree with the details given by him.

939. Then the requirements, in addition to those for domestic purposes, are what?—Streets, public parks, fire brigade, etc, 7 gallons; wash houses, baths, slaughter houses, etc., 5 gallons; horses, cattle, carriages, dogs, etc, 2 gallons; gardens, 16 gallons, making a total of 60 gallons per head for a population of 100,000 whites, with a proposal to increase the amount by 10 gallons per head if the population reaches 200,000.

940. In these figures you have given us you estimate the amount required at 60 gallons per head?—Yes, and I should like to mention that the amount is inclusive of the percentage for waste.

941. You think the streets in Johannesburg are exceptionally large in area?—Yes, they are.

942. Can you give us some details of mileage?—The total mileage of the streets in Johannesburg is 201½ miles, with an average width between the foot-paths of say, 33 feet. That is the portion that will require watering. It gives a total area of approximately 4,137,500 square yards.

943. How does this compare with some other towns, say Glasgow; I think you have some statistics about Glasgow?—Glasgow, with an area of 18½ square miles or double that at present included in the Johannesburg Municipality, has, I believe, 181 miles of streets, so that the proportion is very different.

944. Yes, can you give us some idea of the proportion?—The proportion is more than double in Johannesburg.

945. That is to say, you have more than double the street area here than you have in Glasgow?—Yes.

946. What proportion of the street area do you estimate will require watering daily?—At present?

947. Yes?—I think we ought to try to water at least one-third of the present area of the streets.

948. And how many times a day?—Three times a day.

949. That is except when there is an effective rainfall?—Yes.

950. (*The Chairman.*) Do you mean that the remainder should receive no attention?—No. The idea is that two-thirds of the streets are not, in the strict sense of the term, streets at the present time although they are shown on the maps.

951. You would not at all water the other two-thirds?—No.

952. (*Mr. Lance.*) That is to say, they are not formed streets?—They are not formed streets.

953. And as the population increases a larger proportion of these streets will become formed?—Yes, long before we get a population of 200,000 it is probable that the whole of these streets will be formed.

954. When we have a population of 200,000 whites, what proportion of this area you have mentioned will then require to be watered?—About one-half.

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955. And the number of days of the year on which you estimate the watering will be required?—I put it down at 300 days.

956. That is gathered from your experience extending over several years past?—Yes.

957. These figures you have given will require a quantity of water equal to five and a half gallons per head?—Yes, 555,000 gallons, which gives approximately five and a half gallons per head of the population. There is another point here that I omitted to state, viz., two gallons are added for Fire Brigade, public parks, etc., which bring up the amount to 7 gallons.

958. Then public baths, wash houses, and slaughter houses?—These are put down at 5 gallons per head of the population.

959. You estimate they will require that?—Yes.

960. Can you give some reasons for that being somewhat high?—Yes, the demand for water in this country is greater than in other countries. I think more washing of clothes takes place, and generally speaking I think that the water supply should be very much greater here than in most towns.

961. Can you tell us what the practice hitherto has been here with regard to the washing of clothes?—The practice hitherto has been to allow the washing to be done in rather filthy sluits.

962. It has been taken away to a large extent?—Yes, outside the town.

963. And the intention now is to supply public wash houses to deal with that?—Yes.

964. Now take horses, mules, cattle and other animals, and carriages?—For horses, etc., I have allowed 10 gallons per day, and for cows and oxen 11 gallons per day. I have some details in connection with the requirements of animals which it might be well to give:—

Horse	...	...	...	15 gallons.
Mule	...	...	...	10 „
Pony	...	..	...	9 „
Ass	...	...	...	7 „
Cows	...	...	...	12 „
Oxen	...	...	...	10 „

965. And these work out at what you have given per head of the population?—Yes. I think my figures are quite low enough, becase Humber in his work on Waterworks gives the amount of water for horses for drinking and washing at 16½ gallons. I have only allowed 10 gallons.

966. You have given for gardens, I think, 16 gallons per head per day, can you give us some data how you arrive at that?—It is very much under the Pretoria figures. With regard to gardens it is difficult to arrive at any exact area but I estimate after careful consideration that on a population of 100,000 whites it would be fair to take about one-sixth of the whole area of the town, less the roads, increasing to one-third for a population of 200,000 whites; this leaves an area of about one square mile. Allowing for watering this to the extent of only double what is put on the roads, 1,600,000 gallons are required at the present time, giving 16 gallons per head of the white population.

967. On the present basis of the white population?—Yes.

968. So that you have allowed for putting on gardens double what is put on the roads, and that brings it up to 16 gallons per head per day?—Yes.

969. You are aware that a very much larger quantity than this is frequently used on gardens?—I should think so.

970. I see you have given 40 gallons per head for natives. Do you consider that to be within the mark?—I think it is a very fair estimate for natives. It might be quite sufficient but still I think it ought to be provided for them.

971. And if there should be any margin over from that it will be fully taken up by other requirements?—Yes, I should think so.

972. Then the further 10 gallons per head per day, which you estimate as required in the future—you consider that to be warranted by the statistics you have already put in?—I think it is very reasonable.

973. You have seen the evidence given by Mr Pistorius in regard to the population?—Yes.

974. Do you agree with that?—Yes.

975. Can you tell us how the present normal population at 100,000 has been arrived at?—Well, the population has been arrived at partly from the census of 1896 and partly from the number of houses built since that time.

976. And you have taken the average number of occupants per house, havn't you?—Yes.

977. I think you have taken it at five occupants?—Yes.

978. Which you consider to be correct?—Yes, I think five is quite a reasonable number to take.

979. So that that would bear to some extent on the statistics put in of the number of persons per leading?—Yes, but in counting the number of persons per leading I allowed 10.

980. What I mean is this: That you will have a comparatively small number of persons per leading?—Yes.

981. And you estimate that the present normal white population may double within the next five years?—I think it is very likely.

982. And the black population increase to 80,000?—Yes.

983. Making a total of 280,000, or possibly 300,000?—Yes.

984. When the population reaches that figure, what will be the total quantity of water required per day?—19,200,000 gallons.

985. You have heard the evidence given by Mr. Willcocks of the advisability of obtaining supplies from different sources. Do you approve of that?—I think it is a very good idea to have the water brought in from other than one source.

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986. And from the point of view of the town especially, you consider it desirable that water should not need filtration?—Certainly, if possible.

987. Can you form any opinion as to the desirability of water from the dolomite or other sources?—From a town point of view I think the water from the dolomite formation is very good water and is quite suitable for ordinary purposes.

988. Do you consider it would be better for town purposes than water supplied from the Vaal River or surface drainage?—No, I would not like to say that.

989. On the question of the sewerage scheme, you heard what Mr. Willcocks said. Did you agree with him?—No, I did not. I think it very desirable indeed that we should have a water carried sewerage scheme if possible.

990. Mr. Willcocks referred to danger of percolation with the sewerage system. I suppose you do not agree with him with regard to that?—Certainly not, because the area of the portion of the ground from where you will probably take your water would not be affected by that at all.

991. (*Mr. C. T. Thomson*, representing the Johannesburg Waterworks Company.) What are your qualifications do you say, Mr. Andrews, as an Engineer?—My qualifications are that I have had about 16 years' experience of municipal work. I was 4½ years with the Bournemouth Improvement Commissioners, and 4 years at Hornsey Local Board, London.

992. Do you belong to a Society of Engineers?—Yes, I am an associate member of the Institute of Civil Engineers, London, and a member of the Council of the Association of Engineers in South Africa.

993. But the bulk of the time you have spent in connection with the town of Johannesburg?—Yes, the bulk of the time.

994. Now you say, Mr. Andrews, that we should have 19 million gallons?—Yes, I think we ought to have 19 million gallons.

995. At present?—No, that is the ultimate maximum.

996. And with a population of how many?—300,000.

997. What do you consider would satisfy the requirements at present?—I believe the present requirements could be satisfied by 40 or 50 gallons per head. I think it would be undesirable until we get a sewerage scheme to increase the water supply to any great extent.

998. What do you reckon the population of Johannesburg is at present?—100,000 whites and 60,000 blacks. That is within a three-mile radius.

999. Do you know what the present quantity of water supplied by the Waterworks Co. amounts to?—I only have the figures mentioned in the Blue Book, and these figures I mentioned a little time ago.

1000. A little less than a million per day?—Yes. It gives you an average of 900,000 gallons per day, but, then of course that does not represent the maximum.

1001. And that at present is meeting the requirements of the town?—Presumably so, the portion they supply.

1002. There is no scarcity of water. The Waterworks Co. can supply more if required?—I believe they can.

1003. Now, taking it at the rate of 40 gallons per head per day, that would make four million gallons which would be required per day, instead of 900,000?—Yes, but there are 60,000 natives also to provide for.

1004. What is the total amount you say should be supplied?—I think you ought to take it at 40 gallons all round for whites and blacks. Forty gallons on a population of 160,000 gives 6,400,000 gallons.

1005. That is the quantity you say should be supplied to-day?—Yes.

1006. How are you to dispose of the extra waste of 5½ millions until we have a drainage scheme?—The greater proportion of that would I think be used for gardens. There are a large number of people now who would use a large amount of water for gardens if they did not have to pay so much for it.

1007. How much of that do you estimate would be used for gardens. You see we are in a town where there are comparatively few gardens, and that water would have to be carried away?—It would be for the Council to consider the question of disposing of the water. I have no doubt the Council would be quite ready to prepare a scheme for a matter of that sort.

1008. At present the waste is being carted away in tanks?—Yes.

1009. And the number of these tanks would have to be enormously increased?—Only provided they keep on with that system.

1010 In what other way can they convey the water away unless they provide a drainage scheme?—They can have a temporary scheme and convey the water away by gravitation.

1011. Down the gutters?—No, by means of pipes.

1012. A scheme of that kind would take some time to carry out?—Yes, it would probably take eighteen months.

1013. At an expenditure of what?—It all depends on the distance we would have to go with our outfall.

1014. As an engineer can you make a rough estimate; you know the conformation of the country?—It is quite impossible for an engineer to give an estimate off-hand for a scheme when he does not know what the extent of that scheme will be.

1015. Well, then, you do not consider it would be advisable under present conditions to increase your consumption from 900,000 gallons to 6,400,000 gallons?—Oh, yes, I do.

1016. At present?—Yes.

1017. And yet you do not know how to dispose of the extra water?—I did not say so.

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1018. You told us the Town Council would have to prepare some scheme?—I presume they would refer the matter to their engineer and ask him to formulate a scheme for disposing of the water. It is quite an easy matter.

1019. You told us that the consumption of water for Port Elizabeth and East London is 13 and 13½ gallons per head per day. Can you tell us how the health of these towns compares with the health of towns which have a much larger consumption of water, such as Pretoria and Durban?—No, I cannot.

1020. Pretoria, you know, is an unhealthy place?—I would not like to say it is unhealthy, but I should not like to live there.

1021. Have you ever seen excavations made in Pretoria to a depth of two or three feet?—Yes.

1022. And have you noticed that where you go down two or three feet you strike water and a considerable amount of moisture?—Yes, there is a great deal of moisture.

1023. The whole of the substratum is soaked with water?—Yes, more or less

1024. And that cannot be healthy in any town?—I would not like to say that. For instance, you can have a stream of water underneath your house and it would not be unhealthy.

1025. Yes, but I am talking of this soakage. Now you say that the water supplied at present from the dolomite is good?—Yes, I think it is a good water.

1026. And you also advise that water for the use of the town should be such as would not need filtration?—Yes.

1027. If possible, you should get it from a source that should not require to be filtered?—It would be better.

1028. Therefore, you would not recommend the Vaal River water, which would require to be filtered, as against the dolomite water?—No, I would not.

1029. (*The Chairman*). Mr. Andrews, with regard to the financial side of your proposals, have you attempted to estimate the total cost of supplying the whole of Johannesburg with 19 million gallons. I have not gone into it in detail, but I make it £150,000 per annum for each sixpence per thousand gallons. You do not think that would be an excessive amount for the town to pay?—No, I do not think that would be an excessive amount. For instance, the amount per head of the population, which is the basis I have gone on in this scheme, was in the case of Dublin £1 17s. 6d. In Glasgow the cost per head was £3, Manchester £2 18s., Birmingham £3; and in Bradford the cost was £7 per head of the population. I think that a water scheme for Johannesburg ought not to cost more than £7 per head of the population at the very outside.

1030. On the outside figures I do not make it half of that?—I am including the whole of the works, mains, and distribution.

1031. You are talking of the first cost?—Yes.

1032. I beg your pardon, I have been talking of the actual cost of delivering the water.—The actual cost of delivering the water would not be much more than £100.000 a year. Mr. G. S. B. Andrews. December 30, 1901.

1033. The average citizen has not got anything to do with the cost of the works; he is concerned only with the payment for the water. So I take it that the cost for him, if you reckon it at 2/6, would work out at £768,000 per annum. He is not concerned with anything but the working part?—Yes, but the half-a-crown is rather high.

1034. Let us say then that the cost would be £150,000 for each 6d. per 1000 gallons?—If you take £100,000 per annum or 10,000,000 gallons it gives you approximately 6d. per 1,000 gallons.

1035. You are working it out from the other end?—Yes, I am, but that is what it works out at; and if we take 19,000,000 gallons, the price should not exceed 6d. per 1,000 gallons.

1036. Are you assuming that water can be supplied at 6d. per 1,000 gallons?—No, that is for the absolute cost of pumping. What I maintain is that water ought to be brought into Johannesburg at 1/6 per 1,000 gallons.

1037. That would work out at £450,000 per annum. You think the town could stand that easily?—Oh, yes, I think so.

1038. I suppose you have not been into the financial side of the scheme?—No, I have not.

1039. Because I was going to ask you to say how much would fall on the rates under your scheme, but it is no good pursuing the point. It can be found out by adding up what you put down for streets and public baths and wash houses but not slaughter houses, for which you would probably make a charge.—We would make a charge for slaughter houses and public baths.

1040. Public baths?—The people would be charged for the use of the baths and that charge would include the cost of the water.

1041. It is probable the Town Council have considered it and do not think there would be any excessive burden imposed on the rates in supplying the quantity of water you suggest?—The Council took that into consideration and they are of opinion that it would not be an excessive burden.

1042. Of course if you want 19,000,000 odd, we have also got the outside districts and the Mines to consider and these might possibly ask as much, so that the Commission has the problem of finding at least 40,000,000 gallons per diem?—It is quite possible. There was mention made at the last meeting whether the Council would be prepared to guarantee this quantity of water.

1043. Yes, I asked that question?—I do not see how it is possible for the town to make any guarantee in connection with the consumption of water.

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1044. Then they would ask a Public Board to provide water to the extent of 19,000,000 gallons a day and would not promise any sort of guarantee?—I do not see how any Council can possibly be expected to guarantee what amount of water 100,000 persons would use.

1045. And yet they are to impose on somebody the task of spending large amounts in finding this water?—It has to be done by municipalities in England. Take a case in England where the engineer was hauled over the coals for underestimating the ultimate requirements of the town. "And you call yourself an engineer," asked one of the Councillors. "That's just it," was the reply, "it seems to me you don't want an engineer, you want a prophet."

1046. But it seems to me there is a difference. There you had only one Municipality concerned, and here you have a number of bodies in partnership; and do you think that any one of these could be allowed to leave the others in the lurch?—Supposing the Municipality had to provide these works without any outside Board, they would have to make provision for this supply of water even if they did not use it, and, therefore, I think it would only be fair if anybody else is going to supply the water that they should do the same thing.

1047. No; if you supplied it yourselves and provided for too great a supply you would have to stand the racket. But because some other person has supplied it, you say they must take the consequence?—Don't misunderstand me, Sir. There is a large difference in the amount of water required per day between the summer and the winter months. The Council would naturally want provision made for the maximum quantity. Supposing for a few days in the year we only pump two-thirds of the quantity we should want as a maximum, still I take it you would make provision to give us the maximum amount.

1048. You must have pipes of adequate size to supply the maximum amount you require?—That is my point. Supposing the Council do not take the maximum amount of water are they going to be charged for the water they do not take?

1049. I think, Mr. Andrews, we shall have to get the Council before us if we are to go into that. We had better leave it. You were asked some questions by Mr. Thomson which turned on the words "at present." I am not quite sure that there was not confusion in your mind. When Mr. Thomson asked the amount of water required at present I presume he meant to-day. He did not mean as soon as the normal population has returned. Then, I take it, you will not be satisfied with 900,000 gallons?—Oh, no, certainly not.

1050. You see, there is a difference of meaning attached to the words "at present"?—If these 900,000 gallons are sufficient for the present population, as soon as the whole of the people return I do not think it will be enough, and I presume that is why the Waterworks Company is increasing its plant.

1051. And you cannot immediately increase your supply to 6,400,000 gallons?—No, sir.

1052. In any case the plant is not available for it?—No.

1053. It would take a considerable time to supply this amount, and during that period you might be able to arrange for carrying off the surface water as soon as the scheme is ready?—Yes.

1054. There is no difficulty?—None whatever.

(*Mr. Thomson.*) The data given before the Concessions Commission referred to 900,000 gallons per day, but the consumption to-day is not three-quarters of a million.

1055. (*The Chairman.*) How long do you think it would take to construct a sewerage system for Johannesburg?—It would possibly take between three and four years, but I think that a main outfall sewer could be used in two years, or in less than two years after the commencement of the work.

1056. Before you get your side connections in?—Yes. That is to say, instead of taking the night soil to a depositing site as at present, it could be deposited at a central station and allowed to flow by gravitation through the main sewer. I think it would be a great mistake to allow the surface water to go into the sewers.

1057. The two systems would be constructed independently?—Yes, I think it a very essential thing in Johannesburg to have what is called a separate sewerage system, that is to say, the sewers must be used solely for the purpose for which they are intended and separate pipes and culverts for surface water only.

1058. May I take it that in your opinion you would commence constructing a surface drainage scheme as soon as it is likely that this water scheme would be proceeded with?—I would not include the slop water in the surface drainage scheme. The slop water should form part of the sewerage scheme.

1059. Anyhow you think it is possible for the Town Council to make provision for removing the water as quickly as we can bring it?—Certainly.

1060. With reference to the consumption in the United States, do you know how they charge there?—In some places by meter and in some places by rate.

1061. In the case of the highest figures you quote do you know whether they are fixed by rate or meter?—No, I cannot tell you that. The figures are taken from Rafter and Baker's book which does not give these particulars.

1062. The gardens in Pretoria you say are supplied separately?—In Pretoria they have a Water Works Company which supplies the water through pipes and then they have the old original supply of the town which flows by means of channels along the sides of the streets and this water is used to irrigate the gardens.

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1063. In some cases they have stand pipes all over the gardens. You are only referring to those where the water is let in from furrows?—Yes. I have to rely upon those figures, the information obtained from Pretoria by the statistician of the Council.

1064. I daresay you are aware the system of charging in Pretoria is unique in the world?—Yes, I am.

1065. Are there any wells in Johannesburg in addition to the ordinary supply?—Yes, a very large number.

1066. Are they all right from a sanitary point of view?—I believe some of them are not, but the Council is taking steps to have these closed up. In Fordsburg the Council is having stand-pipes put up all over the District in order that the wells may be closed.

1067. A certain percentage are all right?—Some of them may be all right.

1068. Has it any appreciable effect on the supply? Do you suppose this source is worth talking of?—Yes, if you take it over the whole year.

1069. You have no statistics on the subject?—No, I have not.

1070. Your estimate for natives of 40 gallons per head is, I suppose, pure guess work?—More or less. It is taken on the basis that if a white man wants 60 gallons a Kaffir ought to have 40 gallons.

1071. You have not studied the Kaffir and his requirements?—Not in detail, but I have studied them so far that I think the natives could be very much cleaner than they are at the present time and should have the facilities for washing that they ought to have.

1072. Even in the case of whites the amount for personal ablutions is not very large?—I would rather leave that question to the medical men.

1073. I mean the proportion in your figures that comes under the head of personal washing?—I have given here the amount of 30 gallons for domestic supply.

1074. Yes, but that includes lots of things?—Yes, that is made up according to the medical evidence.

1075. I suppose it would be fair to say that in taking a round figure like 40 gallons, you thought that if it were not required, it would leave a margin for something else?—Yes, I have mentioned that in my report.

1076. (*Mr. J. W. Quinn.*) Mr. Andrews, with regard to the amount of water being supplied by the Waterworks Company in Bloemfontein, I understand you to say this is quite a new company?—So I understand.

1077. So that very likely in that case a large number of people are using the water from sources they had used before the Waterworks came in?—Probably.

1078. That may account for the very low consumption?—Yes.

1079. Don't you think that to a large extent the same thing applies to Johannesburg? Is it within your knowledge that large consumers of water have been driven to make wells for themselves because of the high prices charged—for instance, aerated waterworks and breweries?—I certainly think that if water could be supplied at a cheaper rate people would not go to the extent of sinking wells and putting up tanks to catch all the water they can.

1080. Nearly all the large consumers of water, including the breweries, which are very large consumers, have got wells and do not use the Waterworks Company's water. Don't you think that would be a considerable item?—Certainly.

1081. I know a large place where they have well water and water from the Waterworks Company's pipes laid on, but they use forty times as much from the well as from the other?—In justice to the Waterworks Company I do not think it follows that, because a brewer sinks a well that the water is bad or dear. It is because they require a different class of water. I believe a brewery requires a very hard water.

1082. What I want to get at is this. There is a large quantity of water which is not supplied by the Waterworks Company?—Very large.

1083. With regard to the increased difficulty in carrying off dirty water, in the event of your getting a bigger supply, do you intend to provide a temporary scheme to take away the water at present dealt with by the cart system?—That is so.

1084. You also know that for a long time the Council has been pumping slops from a point at Fordsburg to the depositing site?—Yes.

1085. So that the amount of water carried away by the water carts is small compared with the amount pumped away?—Certainly.

1086. And if the town were able to get three times the present allowance of water it is possible that as a temporary scheme a large pipe might be laid from a central station to the depositing site at a cost of from £30,000 to £40,000?—It is a scheme that could easily be carried out, but I should not like to say for £30,000 or £40,000.

1087. So that the suggested difficulty about carrying away the water disappears?—Yes, there is no difficulty at all.

1088. (*Mr. Brakhan.*) In your figures of the requirements of various towns, the figure at Pretoria seems to be high. Is that water which has been pumped from its source into town, or does it gravitate—that is to say the whole qaantity?—The bulk of it has to flow into the pipes.

1089. Don't you think that has an effect on the cost?—I don't think so.

1090. It seems to me to be a matter of no cost if the water gravitates. After the pipes have been laid to hold a certain quantity the cost thereafter is virtually nothing?—The Pretoria Waterworks belong to a Company and although the water flows by gravitation and does not require pumping, they charge from five to fifteen shillings per month.

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1091. But does not the mere fact that the water runs into the pipes and flows by gravitation have something to do with the large consumption, because I take it that this quantity on which you calculated is the amount which is actually used and paid for?—It is for the actual consumption for other purposes than gardening.

1092. The quantity which is being paid for?—Which is being paid for, I take it.

1093. As regards gardens and the allowance of 80 gallons per head, in ordinary times doesn't the water flow along furrows, whether it is used or not?—That is so.

1094. And this figure of 80 gallons is taken from the flow of the furrow, or is it the quantity actually led into the gardens?—That I cannot tell you.

1095. Well, then, of course, this figure of 80 gallons per head for gardens is one which could not well be considered a criterion, because the water which runs down these furrows is surplus water which has to find its way elsewhere?—I think it is some criterion as to the amount of water that would be used on gardens if it could be got at a reasonable rate. A man would not, of course, like to have too much water in his garden. Then, as Mr. Willcocks said is the case in some parts of Egypt, it would become a nuisance.

1096. Yes, but you told us just now that you did not know whether it was calculated on the quantity which runs down the furrows or the quantity used in the gardens?—No, unfortunately, I do not know that.

1097. But you are quite sure that, notwithstanding the fact of a high rate being charged, this quantity of water, the 64 gallons, for other purposes than gardening, is being consumed and paid for?—So I understand.

1098. Now, you stated that the requirements for washing vehicles is 13 gallons. Don't you think that as an average that is a very high figure if you apply it to vehicles in general?—No, I do not think so. You must remember that an ordinary carriage takes far more than 13 gallons of water. Thirteen gallons is very little more than two buckets full.

1099. Yes, but if you take it over the vehicles in general. There is a great proportion which is never washed?—The proportion of carriages in this town, leaving out of consideration tradesmen's carts, is very much larger than in other towns.

1100. So that you have taken an average which is not an excessive rate?—No, I do not think so.

1101. Don't you think also that in the future as in the past a certain percentage of bath water will be used on gardens, and thus diminish the quantity you set down here? I think it is a general rule that bath water is used for gardens?—Yes, but in the majority of cases, unless perfect irrigation takes place, I am afraid the people will be going against the sanitary regulations. The moment a drop of water runs into the street from a garden, the owner is liable to be prosecuted.

1102. Of course, the question has been put before. Forty gallons appear a very high quantity for natives. I know cases where the boys have every facility to have baths, and they are cleanly house boys, and yet their actual demand for water is a small one.—On the face of it it does seem a large quantity for a native, but at the same time I think the natives should be able to wash themselves far more than they do at the present time.

1103. Yes, but do you think they would avail themselves of this quantity or anything like it, even half?—I think they would, undoubtedly, if they had the water.

1104. (*Mr. St. John Carr.*) Mr. Andrews, there is just one point I would like to clear up. When you were asked about the consumption you stated some figures showing the consumption per head at certain towns in South Africa?—Yes.

1105. Can you state whether there is a sewerage scheme in any of these towns?—Capetown and Durban have systems of sewerage; East London has not, so far as I know; Maritzburg has not; Bloemfontein has not, and Pretoria has not. So that you see in each case where a small consumption is shown, they have no sewerage scheme.

1106. Then also I suppose you are aware that there is a system of rain conservation by which the rain water is stored in tanks and reservoirs?—Yes. In many of the houses the whole of the basement is one great tank.

1107. So that this other water is not taken into consideration?—No.

1108. The Chairman asked you whether you thought it would be reasonable that a guarantee that a certain consumption of water should take place, should be given to the Water Board? You understood that the Town Council would guarantee a minimum payment on account of any expenditure in regard to the supply of water?—Certainly.

1109. Those figures you quoted about Pretoria—where did you get them from?—They were obtained by the statistician of the Council and were given by Mr. Karlson the Engineer of the Pretoria Water Works and City Engineer.

1110. So that they ought to be reliable?—Oh, yes, I think so.

1111. (*Mr. Rouliot.*) Can you tell me what basis you adopted in calculating that in four or five years' time there will be 300,000 inhabitants in this town?—It is based on the assumption that this town is going to be a very large one, as it undoubtedly will be, and I certainly do not think that the ultimate population is over estimated.

1112. It is only a guess?—It can only be a guess.

1113. The other day Mr. Pistorius, in giving evidence, stated that he had taken the area in which the 300,000 would be residing and fixed it as within a radius of four or five miles from the Market Square, therefore embracing a portion of the mining area. Can you tell me what proportion of the 300,000 will be residing on the mining

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area?—No, I cannot. If I gave you any figure it would only be a guess. I should like to mention that Mr. Pistorius, stated that the area extended would be within a circle having a radius of four or five miles from Market Square, but I understand the proposed area of the new jurisdiction of the Council would have a radius of six miles, which gives 113·1 square miles, or 72,384 acres, and this taken on the basis of a population of 300,000 is equal to 4·14 people per acre, which is remarkably small. For instance, in Liverpool the number of people per acre is 101.

1114. Now you say that out of 300,000 people about 80,000 will be natives?—Possibly 80,000 natives.

1115. That is also a guess?—Well, it is taken on the general assumption that we shall have a substantial increase in so many years.

1116. So that the native population will be very nearly one-third of your total population. You have also guessed that these natives ought to have 40 gallons of water per head, plus an extra allowance of 10 gallons; which, you say, is a very liberal allowance?—Yes, it is a very liberal allowance.

1117. Now, regarding sewerage, have you considered the scheme from an engineering point of view?—Yes, I have.

1118. Can you tell me where about the outlet of the sewage would be?—If I had my way I should put it down somewhere between the Rosherville Dam and the Black Reef.

(*Mr. Lance.*) I think we should object to this. The evidence is given on the basis of the requirements of the town, and I submit that it is unnecessary to go into these details.

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(*Mr. Rouliot.*) I will tell you, Mr. Lance, why I asked that question—because it seems possible to me that the requirements which have been stated by the Town Council may be a great deal too large. In arriving at the figures you have mentioned a great deal depends on whether a sewerage scheme will be adopted or not, and I want to know whether your engineer has gone into the question. I want to know whether a sewerage scheme is feasible and what are the points in its favour or against it. A great deal will depend on the system adopted for the sanitation of the town.

(*Mr. Lance.*) I submit that there really are objections to going into details.

1119. (*Mr. Rouliot.*) However, I will put my question in another way. I do not want to press for details of your sewerage scheme. What I want to ask the engineer is whether he has considered the matter from an engineering point of view, and whether he considers it a feasible scheme?—Yes, I do.

1120. And also the treatment of the sewerage where it is delivered?—Yes.

1121. You think it is a beneficial scheme and a feasible one?—Undoubtedly.

(*Mr. Lance.*) That is all the evidence I have with regard to requirements.

(*The Chairman.*) Mr. Bell, will you call Mr. Halse?

VAAL RIVER SCHEME (*Continued*).

Mr. HENRY EDWARD HALSE, called and examined:

1122. (*Mr. Bell.*) Mr. Halse, you have made a study of water and irrigation all your life, I believe?—I have.

1123. You are engaged now in some extensive works in the Cape Colony. Will you describe them shortly?—Well, we have the largest agricultural farm in the Eastern Province; we produce the greatest amount of stuff and have the largest amount of land under irrigation, so far as I am aware.

1124. And it was with a view to irrigation that you originally hit upon this Vaal River scheme?—With a view to the large population of the Rand. Irrigation was the primary object.

1125. Since then the scheme has developed somewhat?—It has.

1126. And when you heard that the Commission was sitting for the purpose of considering a water supply for Johannesburg you, in conjunction with Mr. Cousens, submitted this scheme?—We did.

1127. You know the Vaal River very well about the locality of the proposed site?—Yes, I have been there very often indeed. I went up first of all to gauge the falls and make myself thoroughly acquainted with the volume of water and ascertain the irrigation capacity of the land round about.

1128. And what is your opinion with regard to the quantity of water available?—As an irrigation scheme or a water supply scheme? The irrigation matter is more in my line. There is an unlimited quantity of water for irrigating 48,000 acres, which is the amount of land which was surveyed by our representative, Mr. Kilgour of Cape Town.

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1129. Have you read the evidence that Mr. Cousens gave before the Commission?—I have glanced over it, but I have not read it very carefully.

1130. Have you gone into his figures?—Yes, and I quite agree with those figures.

1131. As to the clarification of water, you have had experience of muddy water running into large reservoirs or dams. What is the effect?—Do you mean in this colony or other countries?

1132. South Africa?—My experience is this, that the larger the dam the purer the water near the embankment. The water filters itself, and the sediment and organic matter in suspension goes to the bottom before it gets to the embankment. The nearer the water gets to the embankment the purer it becomes.

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1133. It just settles without being filtered?—Certainly. This is the experience at the dam at Carnarvon where we have between 300 and 400 million gallons, and during the twenty-five years I have been a farmer I have noticed that the larger the dam the purer the water becomes. This I have also noticed on the Continent. Geneva is a very conspicuous example.

(*Mr. Bell*) That is all I have got to ask the witness.

1134. (*Mr. Lance*, representing the Johannesburg Town Council.) On this question of filtration, do you know anything about the Kimberley Waterworks?—No, I have not seen them.

1135. (*The Chairman.*) As I understand, it was only when you learned there was a Water Commission sitting here that the idea of offering a water scheme for Johannesburg presented itself to you?—No, Sir, by no means. In 1889 we secured these water rights for the purposes of irrigation and power transmission.

1136. I understood you to say in answer to Mr. Bell that your scheme was originally devised for irrigation purposes, and that in consequence of hearing of this Commission you had in concert with Mr. Cousens presented these proposals.

(*Mr. Bell.*) The scheme was originated many years ago for irrigation; then the generating of power was suggested, and now it has developed still further.

1137. (*The Chairman.*) I am aware that Mr. Halse has put in certain contracts, but I think there is nothing on the face of these contracts which had anything to do with the water supply of the Rand?—Not in these contracts.

1138. And I suppose this combined scheme, that is to say, your rights on the river and this turbine scheme, have been brought into existence in consequence of this Commission sitting. Is not that so?—Into existence, but in no way to interfere with the intrinsic value of each scheme on its merits.

1139. Because I was not quite clear what brought you before us—whether it was that you had rights in this neighbourhood which in your judgment made your scheme the only practical one for getting water out of the Vaal, or whether it was simply a scheme such as anybody else might have proposed for taking water cheaply and conveniently out of the Vaal River?—No, Sir, I thought this was a golden opportunity for the two schemes, the one being as essential to the progress and prosperity of Johannesburg as the other. We have worked it out elaborately for the last ten years, and I consider it is one of the largest irrigation schemes in the world, and one which would reduce the cost of living in Johannesburg by 50 per cent.

1140. Because for a considerable period you have been anxious to sell your rights to the Secretary of State?—Since October of last year.

1141. Was there not a letter to the Secretary of State as late as September last?—We have communicated with him through an agent.

1142. Your agent as recently as September last was empowered to sell your rights?—No, merely to ask Mr. Arnold Foster, or the Colonial Secretary, what action was being taken with reference to the proposal made to the former. I do not think we repeated our offer, but merely asked what action was being taken.

1143. Is there any objection to my reading his letter?—Not the least.

1144. Your agent writes:

> "For some time past I have received "repeated letters from Messrs. Halse "Bros., of Carnarvon Farm, Cape "Colony, urging me to offer to the "Government on what they consider "to be most favourable terms, all "their interest in the Vaal River "Water Rights, together with an "offer which they make to cut a "canal for irrigation purposes into "many thousands of acres of land "near the banks of this river."

I will not read the rest because it goes into questions of price.—Anything that is written we have no objection to your reading.

1145. All I am concerned with is that on the 3rd September last Mr. F. W. North, acting on your behalf, was anxious to sell these rights at certain prices only.—Anxious to bring the matter to a head.

1146. Then on the 20th September, I think, Mr. North returns to the charge being anxious to settle the matter. What occurs to me from these facts is that these water rights, such as they were, were not rights which in themselves would have had this water scheme built upon them if it were not for the sitting of this Commission?—We personally got Mr. George Forbes to come out from America and give us a report upon a power scheme and a water scheme, which we thought were inseparably bound up together. The scheme was for the general utilisation of water for irrigation and power purposes. It was in 1889 that we got these rights, which we regarded as a valuable asset in view of future developments.

1147. Can you tell me in layman's language the effect of the provisions of these various contracts which you have put in?—All the contracts so far as I am aware are for 21 years, with the right of renewal by Halse Brothers for a further period of 21 years, from the four owners on the Transvaal side and the owners on the Free State, every contract being registered on the title deed of the property.

1148. What is the name of the farm on the Free State side?—Engelbrecht's Drift, Elandsfontein.

1149. On the Orange Colony side I think the farm on Jeppe's map is called Kruisementfontein?—That is immediately below it.

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1150. At any rate you have acquired what are similar rights on two farms on either side of the stream?—That is so.

1151. What are these rights?—The rights are to take out as much water as we require for a term of 21 years, and a further right of renewal for each farm. There are some slight differences in the contract—one man has a right as to leading a two-inch pipe and another man has also some concession—but we have the exclusive right for a term of 41 years from the men named—Howell, Nieuwenhuis, Engelbrecht, and Van Zyl.

(*The Chairman.*) My copy of the contracts is so badly type-written that I have not grasped the nature of the contracts.

(*Mr. Bell.*) I am sorry. I had not seen the copies before they were sent in.

1152. (*The Chairman.*) My impression was that some of these rights were for leading water to a mill?—That was in some of the contracts. They were not all worded the same. One provides for leading a pipe up to a mill and also for using water for "any purpose."

1153. The proprietors of these two farms give you the right to take the whole of the Vaal River if you like?—No. In the contract the canal was defined as 12 feet in width and 4 feet in depth, but a subsidiary contract was afterwards made by which these rights were extended to 150 feet in width in some instances. When we acquired the rights at first the canal was only to be 12 feet in width and 4 or 5 feet in depth.

1154. And was this enlarged to 150 feet?—Yes. I have not seen these contracts, but we authorised the extension and I believe Mr. Cousens has got the agreements.

1155. In your opinion, under the law of the Transvaal and the Orange Free State, these riparian owners had the right to give you the power to take water out of the river sufficient to fill a canal 150 feet in breadth?—That was a mere drop in the bucket compared with the usual normal flow of the river. We are the only riparian owners lower down. We own the water rights as far down as Parys and we have a mill there, so that there were no other rights to be considered for a distance of 35 miles.

1156. I will read another extract from that letter which was sent by Mr. North:

> "We have secured (all dated nine and "ten years back) the rapids (140 "odd feet of elevation) in 4½ con- "secutive miles above Vereeniging, "both sides of the river, all leases "registered or title deeds of the "respective farms for a term of 21 "years and a right absolute of "renewal for a further term of 21 "years. Total annual lease rents "less than £100 a year. The whole "or part of the Vaal can be diverted "on one or both sides by gravitation. "A 2 ft. 6 in. or a 3 ft. weir or "dam across the river will give us "the whole river in winter and as "much as may be required in "summer."

So that you consider that you had power under your agreement with the owners of these two farms to appropriate the whole of the Vaal in the winter season?—Both the contracts were drawn up by the best Free State attorney, and we felt ourselves secure in getting these rights because the water was not used in any shape or form until it got down to Parys, where we own a mill—which was recently blown up—on a 99 years' lease. The water could not be used by anyone else but ourselves between Engelbrecht's Drift and Parys except by pumping.

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1157. So that if your scheme had been carried out in the old days you had no idea of a prospect of war between the two States?—No, because we engaged Mr. George Kilgour, a great hydraulic engineer, and he showed that the percolation would be so great that the normal amount of water would find its way back to the river, and that there would be no appreciable difference in the amount of the flow. I think that is a fact which could be proved on investigation.

1158. Do I understand you clearly to say that from Engelbrecht's Drift right away to Parys you own the whole of the riparian rights on both banks of the stream?—Of any value. Fourteen miles above Vereeniging there is a fall of 22 feet, and we secured it in the same way as the other rights for a term of years, but we found it was useless and allowed the lease to lapse. At the present moment we own all that is of any value between the points mentioned.

1159. I understood you to say that you were the only riparian owners down to Parys?—No. I meant that there were other riparian owners, but that on their portions of the river the banks are 40 to 50 feet high, so that they cannot take the water out.

1160. But the idea of taking water from the Vaal is no novelty whatever. It is a matter which has been thought of by many. Your turbine scheme may be a novelty, but what I want to find out is this—whether, if we did not use your turbine scheme, we could not take water out of the Vaal River by pumping? Have you any riparian rights which could prevent us?—To prevent you, no. You would have a perfect right to pump the dead water, because the idea never was to monopolise or take all the water. It was only a fractional quantity of the flow that we proposed to use, although we had the right to take it on both sides. As I said, we could stop all the water in winter, and yet Mr. Kilgour's statement proved that the normal flow would be very little affected. There are a dozen or more rivers that go into the Vaal between Engelbrecht's Drift and Parys, and the water we took would find its way back, so that the flow at Kimberley would not be appreciably affected. The most crucial examination will show that we asked for no monopoly.

1161. You do not claim that you have a monopoly?—It only exists in name and not in reality.

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1162. Do you claim that we could not adopt a scheme of our own for taking ten or fifteen million gallons out of the Vaal?—Not out of the 5¼ miles over which our servitudes exist.

1163. Above or below you?—Above or below us you could, but if you took too much we would make a noise about it perhaps.

1164. The people below are not likely to make a noise about what you do?—No.

1165. Now these contracts on which you base the whole of your scheme are leases?—Are leases.

1166. Which at the end of 42 years will expire?—They will.

1167. And with no power of renewal?—As a matter of fact there is not, but we can renew them at any time.

1168. Assuming the other parties agree?—I say so knowing the other parties. I know all the owners very well, and I spoke to them in anticipation of the possibility of our wanting to buy the farms, but we considered that the forty-two years, our life time, was long enough. But there was no difficulty with any of the present owners in getting the period lengthened.

1169. But things are altering now?—I do not think it makes any difference.

1170. You have 29 years to run?—Thirty years to run.

1171. At the end of that time the holders of these rights will get possession of your scheme?—We can go and purchase their rights. They are poor Dutchmen who would only be too pleased to sell their rights.

1172. That is assuming a good deal of simplicity for the Dutchmen?—I know these men very well, speaking their language as well as themselves.

1173. At the present time you are inviting us to go into this scheme on a 42 years basis?—That is what we are asking you to go into. As a practical agriculturist myself I want to leave footprints on the sands of time. With us it is not so much a question of power as the advantages which would arise from the adoption of our irrigation proposals. As I told Mr Arnold Foster, we would plant down 2,500 families on ten acre allotments each, and these men could produce from a million to a million and a half's worth of produce for the Johannesburg market, time and distance being practically annihilated by the proximity to the railway. When the question of the settlement of the reservists came up we thought we could put down 2,000 fighting men, and as these men would have eight or ten of a family each this would make from 15,000 to 20,000 souls which could be planted down on the Vaal River with all chances of success—success to themselves, and they would be an enormous factor to the labour supply of Johannesburg by providing cheap food supplies.

1174. But that excellent scheme is in no way tied up with a water scheme for Johannesburg?—There is nothing to prevent you going on with both.

(*Mr. Bell.*) Mr. Halse has referred to his conversation with Mr. Arnold Foster.

(*The Chairman*) I quite understand that. All I say is that two separate things are involved, and that supposing we do not look favourably on this water scheme there is nothing to prevent Mr. Halse dealing with his scheme for the irrigation of 48,000 acres, which is going to revolutionise Johannesburg.

1175. (*Mr. Kitzinger.*) You told us that under the rights acquired by you you could divert the water from the Vaal River for a stretch of 4½ miles on both sides of the river?—You mean our rights extend 4½ miles on each side? No, 5¼ miles on the Transvaal side.

1176. And on the Orange River side?—About three miles. I would not be quite sure, but about that.

1177. And you are able to take water out of the river in practically unlimited quantities?—There are no saving clauses and no restrictions in our contracts.

1178. Can you tell us what would prevent the owner of a farm higher up or lower down the river giving away the same rights that you have acquired?—Nothing whatever, only that the practicability does not exist. But they would not be debarred by law.

1179. Nowhere above or below the 5¼ miles?—Below it they cannot, because we hold all the water rights as far as Parys.

1180. Where is Parys?—Thirty-five miles below Engelbrecht's Drift.

1181. What is the distance between Engelbrecht's Drift and Standerton?—I do not know. I have never been up to Standerton, but I should say 60 or 70 miles.

1182. You say that legally there would be no difficulty in the owner of a farm higher up the river giving away the same rights that you have acquired?—They cannot do it, as according to the configuration of the country the water must return to the river above our falls.

1183. How is that?—The ground rises precipitously on both sides. The river above our proposed intake is practically a lagoon for twenty miles. There are no falls, and nobody could take out the water by gravitation, and if they took it out by pumping it will be discharged into the river again before our intake is reached, because the difference in the elevation is 300 or 400 feet.

1184. But they could do it by means of pumping?—They could take it away by pumping, but what they can take away is too small a fraction for consideration.

1185. Perhaps somebody else has got some other irrigation scheme in view?—We hold the exclusive right of taking water out of the river on these farms, and these farms extend back four or five miles on either side. The area over which our rights extend represents a fall of 400 or 500 feet, and those people could not take away the water by means of a contour canal because we have the exclusive water rights.

1186. You are only speaking of the portion of the country where you have the exclusive rights?—Yes, but no man acquiring the water rights further down could irrigate

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the ground below the fall because he could not pass over the farms in respect of which we possess all rights. The farms extend three or four miles on either side of the river, and owing to the contour of the country any water diverted must pass over these. We hold an exclusive right to carry water over these farms. It is impossible for any man higher up to take water down by gravitation without going over our ground.

1187. If there is such a lot in irrigation as we are led to believe a man might go to a great deal of expense and pump the water over the obstacles?—That he might do. According to the consensus of opinion among engineers, practically the same amount of water as is taken out is returned to the river on account of percolation through the porous soil. Any water used in an irrigation scheme above us must find its way back to the river before it reaches the falls.

1188. What is used in irrigation would not come back to the river?—It does come back to the river—at least one half of it—because the strata consists of porous gravel beds.

1189. There is a difference between the whole and a half.—I have been up the river for twenty miles on either side, and found that the tracts of land which could be irrigated would be very small on that portion. I went purposely to see if the land was suitable for irrigation. A man would think twice before going in for such a scheme there.

1190. All I want to get from you is that any owner of land higher up has the same rights as you and that there is nothing to prevent him taking out the water, but you say in your reply that if he did the water would be bound to come back?—Yes, at least half of it.

1191. (*Mr. St. John Carr.*) In one of your answers you said you supported the figures Mr. Cousens gave, which you said you had glanced over. I should like to know, for the benefit of the Commission, whether you took any measurements yourself of the flow of water?—I was with Mr. Cousens when he took these measurements. I did not take them personally.

1192. Would you be qualified in any way to check his figures?—No. I would not make any definite statement as to these.

1193. You spoke also of the sediment in irrigation dams and said there was practically no matter held in suspension?—I said my experience is that the larger the dam the greater the amount of settlement at the intake. I was speaking of my experience. I spent a week on the river Rhone where it enters Lake Geneva. The water enters the lake in a turbid state and resembles the colour of pea soup, but at the outlet where it leaves the lake it is perfectly clear.

1194. You would not, then, be able to give any evidence with regard to the settlement which would take place in large dams which might be constructed in connection with your scheme?—Only on the broad principle. If the scheme were to take in a stretch of a mile square—the larger the area covered the better—the water would become clearer the further back you went and there would be no lodgment of sediment beyond the first mile from the intake, provided the reservoir was kept full. If the dam were kept full any contaminating matter would be deposited some distance from the outer wall.

1195. Now, for instance, does your scheme provide any means of clearing out the sediment that would lodge in the dam?—No sediment could arise. My experience is that if the dam is kept full no sediment will leave the dam. In the case of Lake Geneva no sediment goes beyond the first two or three miles of the 56 miles of that lake. No sediment could get near your outlet pipes. By diverting the river and taking it over a mile or two of grass you could render the water perfectly pure.

1196. (*Mr. Brakhan.*) I gather that the original scheme was merely an irrigation scheme?—Yes, in the immediate prospect, with the idea of meeting any other conditions that might arise.

1197. Now you told us that the greater portion of the water taken out of the Vaal would be returned?—Yes.

1198. The scheme has been enlarged by degrees from one to deal with irrigation requirements to one to supply the Witwatersrand, first with ten million gallons and then thirty million gallons of water. Do you consider that you have rights which will entitle you to take thirty million gallons out of the Vaal River and convey it to the Rand?—Provided the respective Governments of the two Colonies do not object. The owners have no right to object at all.

1199. I want to get your opinion on this point. Take the case of the owners a little higher up the river, where you told us there are dolomite hills, which might lend themselves very well for the building of dams. There would be nothing in your titles—if you had the right the other people would have the right too—to prevent those owners taking thirty million gallons out of the river?—That is so, but our answer is that the amount of water that would or could be taken out of the Vaal River is so fractionally small, compared with the volume of water available, that it is almost impossible to define it.

1200. I only want to get your opinion on this. You claim the right of being able to take out water from the Vaal to the extent of thirty millions, and I want to know whether in your opinion there is anything to prevent any owner higher up the river doing the same?—It is possible, but highly improbable. I could not stop him.

1201. As regards the quantity, the water could be taken out of the river higher up as well as out of the Wilge River?—My answer is that the river would dam back ten miles. I would dam back at the junction of the Wilge River with the Vaal River. Even if people had the right with the Vaal we have the Wilge River which joins the Vaal further down.

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Mr. H. E. Halse. December 30, 1901.

1202. I don't wish to discuss the configuration of the country, only the question of rights.—No one between that point and the top of the Vaal can enjoy the same privileges that we have.

1203. (*Mr. Lance.*) Might I suggest one question through the Chair? It is as to how Mr. Halse would propose, in pumping from the Vaal to Johannesburg, to get over the provisions of Law 11, of 1894, which provides that water taken out of a public stream shall not be conducted beyond the limits of the farm at which it leaves the river?—Expropriation would be my explanation of that. Of course we cannot go beyond our contracts.

1204. (*The Chairman.*) In other words you would have to get legislation?—Yes, legislation. Our rights cease with the farms on which our titles are registered. I should like to say there may have been some misapprehension with reference to the letter the Chairman read from Mr. North. Had we believed our offer had been considered by the Home Government we would have been very chary in bringing this matter forward, but not having heard from the Colonial Office on the subject this second scheme has been brought forward. Up to this moment we have not heard that our offer has been considered or accepted. We have had no word from Home on the subject.

1205. You don't suppose the Home Government would accept the proposal without consulting the Administration here?—But I believe the Administration had been consulted some months ago.

1206. That of course does not prejudice any findings this Commission may come to in the matter.—I only wish to say that we intended to be perfectly fair and above board in everything we have done in this matter.

(*The Chairman.*) I do not want to suggest for a moment that you have not. In putting the questions I did I wanted to understand what your relations were with Mr. North. I understand quite clearly now.

Mr. RICHARD LEWIS COUSENS, called and further examined:

Mr. R. L. Cousens. December 30, 1901.

1207. (*The Chairman.*) Since last meeting, Mr. Cousens, you have put in the report you were asked for about the gaugings on the Vaal River. I will ask the Secretary to read that report.

The Secretary then read the following report on the Gaugings of the Vaal River.

Gaugings of the quantity of water flowing in the Vaal River were taken in December, 1892, June, 1893, July, 1894, September, 1895, April, 1896, January, 1897, February, 1898.

With the exception of those taken in July, 1894, and September, 1895, all the gaugings proved that the flow of water exceeded 150,000 cubic feet=937,500 gallons per minute. The gauging in July, 1894, was over 40,000 cubic feet=250,000 gallons per minute, and that taken in September, 1895, was (as I have already stated) the lowest recorded by myself, viz:—11,760 cubic feet=73,500 gallons.

The gaugings in 1893 and 1895, were taken in conjunction with Mr. C. T. Roberts, Consulting Engineer, and who was for some time on the technical staff of the Johannesburg Consolidated Investment Co., and who also carried out, with myself, the survey of the proposed works, including plans and estimates.

As a result of the above gaugings, I am of opinion that the average flow per minute, of the Vaal, taken throughout the year, exceeds 150,000 cubic feet=937,500 gallons, which will give sufficient water under the smaller scheme, for power to pump 30,000,000 per diem. Under the larger scheme 111,000 cubic feet=700,000 gallons per minute is all that is required for power to pump 50,000,000 per diem, so that for both schemes there is ample supply.

The gaugings were taken in the usual manner by means of floats.

I did not prepare any exact figures shewing result of gaugings except in the case of those for July, 1894, and September, 1895, the reason being that my gaugings were originally taken in connection with a scheme for transmission of power in which 20,000 horse-power was the basis of supply, so that where I got sufficient water for such supply of power, I took no further data; July, 1894, and September, 1895, showed less than 937,500 gallons (the basis of supply) hence the more detailed figures concerning those gaugings.

(Signed) R. LEWIS COUSENS.

December 18th, 1901.

1208. (*The Chairman.*) That is your statement, Mr. Cousens?—That is my statement, sir.

1209. (*Mr. Lance*, representing the Johannesburg Town Council.) I will just put one or two questions, sir. Mr. Cousens, in giving an estimate for the larger and smaller *schemes, you say that the larger scheme would cost £308,000 more than the other?—Yes,

1210. In that do you include the difference in pipe line?—You mean the pipe line from the dam?

1211. Yes, the pipe line to Johannesburg.—It has nothing to do with the pipe line to Johannesburg.

1212. So that these figures are exclusive of the pipe line?—Oh, yes.

1213. Would you tell us what the difference would be on the pipe line?—It is the same distance.

* See Appendix E.

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1214. Yes. but whether the pipe line carries ten millions or thirty millions makes a considerable difference.—I beg your pardon, I do not exactly understand what you are referring to.

1215. I have got your figures for the smaller scheme of ten million gallons, and the larger scheme is for thirty millions. What will be the difference in the cost of the pipe line?—Three times more. I should lay the pipes three times over.

1216. So that that would be £900,000?—Certainly.

1217. Then the horse power for the ten million scheme you give at 6,000. What horse-power would it want for the thirty million scheme?—It would want three times as much as the other.

1218. And you have allowed for that in this £308,000 additional cost?—Yes, but not so far as the machinery is concerned.

1219. The £308,000 is an extra amount for erecting the dam?—That only refers to the extra cost of the dam.

1220. So that there would be a great deal of extra cost involved besides the cost of the pipe line?—Yes, extra cost of machinery.

1221. Your estimated cost is on the basis of ten million gallons and for anything over that there would be extra cost?—Yes.

1222. You have given us the total cost of the smaller scheme. Can't you give the cost for the larger?—Under the other scheme you can pump out thirty million gallons with storage. The only difference is that under the larger scheme very much more water is stored and that the dam at the foot of the falls will cost £308,000 more.

1223. This storage is in the Vaal River?—Yes.

1224. And you have got to pump the whole amount to Johannesburg?—You mean if you pump the thirty million gallons?

1225. Yes.—The £308,000 only brings the water to the dam at the foot of the falls, and if you want to pump thirty millions to Johannesburg you would have to multiply the cost of the pipe line three times.

1226. Would the other cost be in proportion?—Not quite, but very nearly.

1227. Now you are acquainted with Kimberley, Mr. Cousens?—I am.

1228. You know the process of filtration there?—I do not know it very much in detail. I have only just seen it, and that is a great number of years ago. I do not know whether they have since made any improvement or alteration.

1229. How long is it since you have seen it?—It is about fifteen years, shortly after they inaugurated the scheme.

1230. Their water is taken from the Vaal?—Their water is taken from the Vaal, which is in no way impounded.

1231. You know it costs 3s. per thousand gallons to filter it?—I am told so.

1232. Can you explain it?—There is a very small reservoir at the intake which they pump into first, and then they pump from that to their intermediate reservoir, which is also very small indeed, and from their intermediate reservoir to their service reservoir, which is also very small, and thence to the town.

1233. So you attribute the high cost of filtration there to the want of larger reservoirs?—Yes.

1234. I think you referred to the Rand Mines dam as an instance of filtration?—Yes, of filtration.

1235. Do you know the state of the water when it leaves that dam? Is it fit to drink?—I do not know if it is fit to drink. It looks clear. There may be cyanide in the water.

1236. What you go on is that it appears clearer?—Yes.

1237. In this filtration by settlement would you not in the course of years have a very large amount of sediment in your dam?—There might be a certain amount, but we could scour that through.

1238. Have you made provision for that?—Yes, we have made provision for certain sluice gates, which will scour the whole thing through.

1239. (*The Chairman.*) About these gaugings. The report you have put in gives a list of gaugings you have taken?—Yes. I adhere to these statements.

1240. I am only asking if that is a complete list of the gaugings?—Yes, so far as I have taken them.

1241. So it comes to this, that in nine years you have taken seven gaugings, each gauging for a different month?—Yes, but more than one gauging at a time. I may have taken a gauging several times over.

1242. That would be to check the result?—Certainly.

1243. From these seven gaugings, for the purpose of ascertaining the average flow you have struck out those which you took in July, 1894, and September, 1895?—No, Sir, I have not done that, because I frequently got very much over 150,000 cubic feet. Sometimes, when the river is in partial flood it runs to hundreds of thousands of feet.

1244. I take it that on these gaugings, excluding the months of July and September which you mention, you arrive at your average of 150,000 feet?—Yes.

1245. That means to say that you omitted the whole period from July to November inclusive, and you constructed an average out of five gaugings for the other months of different years. Is not that so?—They very much exceeded 150,000. A number exceeded that figure, I would ask you to note.

1246. It does. At any rate I may take it that on your reputation as an engineer you are prepared to state that five gaugings in nine years were sufficient to enable you to determine the average quantity of water available?—It is also what I know from my own experience and the experience of others.

1247. I am afraid the experience of others is going to be quoted against you by-and-by?—I do not know what that experience is, but I should like to see it.

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1248. You consider that these five gaugings in nine years are sufficient to base a scheme of water supply on?—Strictly speaking, there ought to be daily gaugings.

1249. I want to know if these gaugings are sufficient to base a scheme on?—On a basis of 150,000 feet, the number of gaugings I have given, with my knowledge of the Vaal River, is, I should say, sufficient.

1250. I suppose you would be surprised to hear from any engineer of standing that the flow at Vereeniging itself does not exceed 100 millions per diem?—Cubic feet?

1251. No, gallons. Do you think a suggestion of that kind preposterous?—Do you mean to say it never exceeds that?

1252. No, the average?—I should be rather surprised to hear these figures.

1253. You see we are getting down to one-tenth of your average. Then I take it that but for these isolated gaugings in July, 1894 and September, 1895, you took no gaugings during the dry season?—No. I only took gaugings when I happened to be down at the Vaal River.

1254. You took none that you worked out these figures from? You did not work out any figures in connection with gaugings taken during the dry season?—I did not take any other gaugings beyond those I have reported to you.

1255. Now, Mr. Bennett in his statement says "I think the plans have been very carefully considered and worked out in all their bearings, that the quantity of water has been ascertained by numerous gaugings extending over a series of years, to be amply sufficient." That statement is evidently arrived at from a perusal of your report?—Yes, from the information I gave him.

1256. And, therefore, his reference to the "gaugings extending over a series of years" refers to five gaugings taken in nine years?—It refers to the number I have given there, yes.

1257. Seven minus two. Assuming you are correct as to the average flow of water being so many gallons per diem, if you attempt to deal with the water supply on the basis of that average does not that imply that you are able to impound every drop of water that comes down in the year, and you average the amount you draw from it? Supposing a flood comes down and you gauge that flood and you say there are so many thousand million gallons coming down, that raises enormously your daily average. Do you have any human means of impounding that water and storing it up against a period of scarcity?—If you impound a large lake as we propose to do and a flood comes down the water would flow over that lake leaving say six inches more in the lake.

1258. You say there are so many million gallons a day which you can deal with for the purposes of your scheme. That average multiplied by 365 would mean every drop of water that had to come down during the year?—Yes.

1259. But do you suggest that under any possible scheme you can impound every drop of water that comes down the Vaal during the year? There must be times of flood when water would disappear over the banks of your dam?—The chances are that the dams would overflow periodically.

1260. Therefore, to construct an effective average, which you say you can deal with every day, surely you ought only to take into account the amount of water you can make use of and store up? Is not that common-sense?—Yes.

1261. And that would be very much less than the amount arrived at by taking the whole flow of the Vaal?—Yes. In my report I say I believe the average of the Vaal is considerably over 150,000 cubic feet.

1262. What I suggest to you is that that does not help us. The point is to ascertain how much we can make use of.—We can estimate the amount of water in that dam, and I have done so in my figures.

1263. Once you are certain the dry period won't be too long you can say "I have sufficient storage to give me all the water I want during the dry season"?—Yes.

1264. Have you any figures to show for how many months during the dry season there is a shortage?—I should say three or four months.

1265. Not more?—We have some rain during eight months.

1266. During how many months would the flow be less than the amount you would require to drive your turbines?—I should say not longer than three months.

1267. You say that for nine months in the year no dam is required?—I should say so unless there was a very severe drought.

1268. Then you would say that for 120 days in the year you would have to rely on the dam?—Yes, we would have to draw from the storage water in the dam.

1269. And you say that your provision for this in the scheme is more than adequate?—Yes.

1270. I think, in your evidence, you talked of a supply sufficient for eighteen months?—Yes. I have told you that you can get nine months' supply, and in my report I showed how it was possible to retain sufficient for eighteen months. The difference is owing to the possibility of the flow receding.

1271. I should like you to explain to the Commission something as to the actual working of the turbines. I think you said that to get 30 millions a day out of the Vaal you would require 700,000 gallons per minute?—That is about it.

1272. Which I make to be something over one million gallons per diem?—Yes.

1273. In your scheme for ten millions you reckon 50,000 cubic feet a minute, which I think works out at between 450 and 500 million gallons per day?—Yes.

1274. Do I understand that the greater the amount of water that has to be pumped by the turbine the greater economy you get, because your figures seem to indicate that for the larger scheme proportionately less water would be required?—No, sir. I made the statement that for pumping 30 million gallons it will take 150,000 cubic feet flowing per second.

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1275. One hundred and fifty thousand? For the larger scheme you say 111,000 feet? —Yes. We get a greater fall with the larger scheme.

1276. This economy is brought about by your having a greater fall?—Yes.

1277. I have never seen a turbine, but I take it that the water has to flow through a closed pipe and as it passes through it catches the turbine?—Yes, it presses on the blades.

1278. Like an ordinary screw?—Yes, some of them are like that.

1279. How many of these instruments would you use for 30 million gallons?—I think we should adopt the unit of 3,000 horse-power each.

1280. And that means a pipe of what diameter?—That depends on what kind of turbine you use.

1281. Now it occurs to me to ask—Can a thousand million gallons flow through these pipes per diem?—Oh, yes, it is done at Niagara.

1282. And the head of water there is what? —About 130 feet.

1283. Now I understand that in your larger scheme you abandon the idea of a pipe coming down from the canal to your turbines and draw your water from the lower edge of the dam?—Yes, by pipes.

1284. And your turbines are placed at the foot of the dam?—Yes, close to the foot of the dam.

1285. The total height of your dam is 120 feet?—Yes.

1286. Where are your intake pipes?—We put them about three-quarters of the way down the dam.

1287. Then you have a head of water of 40 feet?—No, we would not put them above one-third of the height of the dam up.

1288. Your head would fall possibly from 120 to 40 feet?—Yes, possibly. That is why I calculate on half the total storage.

1289. And in estimating the water required to drive the turbines it is evident we must deduct one-third, because you do not get the benefit of the full fall?—That is the reason why I have deducted one-half from the storage capacity of the dam.

1290. Where do you deduct it?—I said the storage would last eighteen months, but on account of the decreased height if you draw on the storage I only reckoned that as nine months' supply.

1291. I see, and you have deducted it simply on account of that?—Yes.

1292. And for three months in the year it is a great deal less than your 110 feet head?—Yes, you would get slightly less.

1193. That would affect your pumping capacity of course?—Yes, you would use more water.

1294. And you have allowed for that?—Yes.

1295. Are there any instances of successful turbines on this scale with the same sort of water arrangements?—There are a large number of instances all over the world of turbines being used for power supply.

1296. We will leave Niagara out of the question?—Yes, exclusive of Niagara.

1297. Can you name any?—I do not think I can from memory, but I can hand in to the Secretary a list of a large number of places where turbine schemes have been erected.

1298. In Question 623, I think it is, among other items of first cost you provide £25,000 compensation for the holders of riparian rights?—Yes.

1299. Who are they? What are the rights which you require to compensate for?—The riparian rights. We have handed in these documents.

1300. But these owners do not require £25,000 after giving you a lease?—No, sir, that refers to ourselves.

1301. You want this as the holders of the riparian rights?—We do.

1302. You must explain. That is to say, Messrs. Halse, as the proprietors of these rights, put their price at £25,000?—Yes. That includes all those who are interested in the scheme.

1303. Now, by constructing your dam 120 feet, as I understand, you would dam back the water for thirty or forty miles above? —Not thirty or forty miles in length.

1304. Thirty or forty square miles. Do you know anything of the contour of the river banks?—Oh, yes.

1305. How far would this lake submerge private property?—Well, there are certain valleys that would fill up.

1306. No land in respect of which the owner would have to be indemnified?—There was no land there before the war that was cultivated to any extent.

1307. Do you think you would have to compensate these owners?—I think that ground would have to be bought.

1308. That will add something more to the cost of the scheme?—If the larger scheme be taken up that would be so.

1309. You are not prepared with figures as to the extent of the submergence?—The total extent, I take it, is thirty square miles.

1310. Yes, but I am referring to the character of the land submerged?—I would have to make a very detailed survey, which would take a long time.

1311. I do not want you to do so. I only wanted to know if you had the figures. Because, you recollect, that one of the questions, No. 672—I do not know who was examining you—reads:

> "There is only one other question that "I wish to ask, and that is with "regard to these figures you have "submitted. These are reliable?— "Yes. We are prepared to carry "out the work at the figures we "quote here."

Did that relate to the larger scheme or the smaller scheme?—That relates to both.

1312. Then you recollect you gave us an estimate?—Yes.

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Mr. R. L. Cousens

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1313. Then, since that estimate was made, you told Mr. Lance that you would have to allow three times more for laying pipes?—That is on the basis of the ten million scheme. I do not know whether you would like us to supply ten or thirty million gallons.

1314. Am I not right in stating that the cost of the 30 million scheme—

(*Mr. Bell.*) Both schemes presented are on the ten million basis, and the cost has got to be extended for the 30 millions.

(*The Chairman.*) Here is the memorandum,* and according to it the cost of the larger scheme would be £1,122,015.

(*Mr. Bell*). The basis of calculation of the cost is the ten million scheme.

(*The Chairman.*) I take it from what you say that that is not the cost of the scheme but the cost of a portion of the scheme.

(*Mr. Bell.*) The memorandum handed in, headed Memo. No. 2, refers to a smaller scheme. They are both included there.

(*The Chairman.*) I do not see your point.

(*Mr. Bell.*) The first gives a similar scheme, which is to include a canal. The second is the larger scheme, but they are both based financially on the ten million gallon scheme.

(*The Chairman.*) Then I take it from you that in the first statement you made you call the cost the total, and then you leave us to find out that it is not the total cost.

(*Mr. Bell.*) It is headed "Total, 10 million gallons."

1315. (*The Chairman to witness*). Then, I understand you presented us with two alternative schemes for ten million gallons, the only difference being that you can work the second up to 30 million gallons?—Yes, you can also work the smaller up to 30 million gallons if you wish to do so.

1316. What object would there be in raising the cost wantonly from £814,015 to £1,122,015 if there was not a larger supply of water?—The larger scheme conserves a far greater quantity of the water.

1317. But you say the smaller scheme is sufficient?—In my opinion it is sufficient.

1318. Then why give us another scheme which would cost £300,000 more?—Because it would store so much more water.

1319. You advanced the statement to us on ten million gallons?—Yes, on the basis of ten million gallons.

1320. Subsequently you state 30 millions?—I stated that you can get 30 millions if you require it.

1321. Was not the whole idea in putting in the second scheme to present a new scheme?—When I first considered these figures, I did not know what the requirements for the Rand would be, but the evidence shows that you can get 30 millions if you want it. My opinion is that you can get a far greater amount.

* See Appendix E.

1322. At any rate the point is that we have no figures that show the inclusive cost of laying down your scheme for providing 30 million gallons per diem?—The amount of cost?

1323. We have no inclusive statement of cost, of the whole cost of laying down the plant for supplying 30 million gallons?—No, it is for ten millions.

1324. The utmost we have got is a project for supplying 30 million gallons *plus* a project for making a dam?—At the foot of the falls.

1325. Now in Question 657 you referred to the possibility of steam pumping, and the utmost length to which you seemed inclined to go was to say that it is most unlikely to be wanted.—No, I have not gone further.

1326. Therefore, it would seem rather as if prudent people who carried out your scheme would have to supply duplicate pumping machinery by steam?—In my opinion, no.

1327. You have not gone so far as to say more than that it is most unlikely?—That is my statement.

1328. You would not like to go further?—I would say that up to 30 million gallons at least, I do not think that any steam pumping would be required.

1329. The advantage you offer is that by using turbines instead of coal there is a saving of £25,000 per annum?—Yes, with coal at 5/- per ton, but it is not in many places that you can get coal at 5/- per ton.

1330. That is what you put it at. Would you multiply the saving in the cost of coal by three for the thirty million gallon scheme?—Yes.

1331. To get that we have to build this dam of 120 feet, which you estimate to cost £450,000, and we have to submerge 40 square miles of land and indemnify the owners. Do we have to do anything else in consequence of using these turbines instead of steam?—No, I think that would be about all.

1332. I asked you just now about the places where this turbine business had been carried out. Have you any general statement to make with reference to the running of turbines without interruption?—You mean on the experience of other places?

1333. I am going on the question of safety.—I do not think they stopped, for instance, since they commenced at Niagara, and by looking up technical books I could quote other places.

1334. Do you provide for reserve turbine power as a competitor would provide for reserve steam plant?—Yes.

1335. Now in question 658 you brought your lake into competition with Lake Geneva. I suppose the amount of settlement effected is more or less dependent on the size of the lake?—Yes.

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1336. I suppose the water which flows out of the Rhone into Lake Geneva and out of it again has a better chance of settling before it goes out again than the water which flows into your lake?—Yes, it is a larger sheet of water.

1337. Do you think the process would be finished before the water is pumped?—I think the water would be largely clarified but perhaps not altogether.

1338. Therefore, up to the foot of your containing wall you must have sediment?—It might gradually work its way down to that point.

1339. Have you any statistics as to the amount of solids in suspension which the Vaal brings down when it is in flood?—I have not that matter here.

1340. Have you ever studied it?—Only very slightly.

1341. Have you had any experience of dams—small ones, it is true—in Cape Colony?—At the present time I am connected with a work of a similar nature to this.

1342. I think I am right in saying they silt up rather rapidly?—They do sometimes. It depends on the part of the country.

1343. Would you consider the Vaal a particularly turbid stream in flood?—Yes, I would call it a turbid stream in flood.

1344. Do you know what it brings down chiefly — mud or sand?—Both in times of flood.

1345. I suppose the task of cleaning out the dam would be very expensive?—No.

1346. How do you do it?—Simply with sluice gates near the bottom of the dam.

1347. (*Mr. Quinn.*) I have only one question, Mr. Cousens, to ask you. You state in your report of the gaugings of the flow of the Vaal River that the average exceeds 150,000 cubic feet per minute?—Yes.

1348. Can't you get to exact figures?—No, the gaugings varied very much.

1349. Can't you give us all the variations?—No. I only made a note of where it exceeded 150,000 cubic feet.

1350. When you made those notes did you keep a record of how much in each instance the flow exceeded 150,000 cubic feet?—No. It was sufficient for me that it exceeded 150,000 feet.

1351. So that these gaugings are very unreliable if you are not able to tell us what they are in detail?—I say the flow exceeds 150,000 cubic feet, but sometimes it goes up to hundreds of thousands of cubic feet when the Vaal is in flood.

1352. When you knew there were 150,000 cubic feet you did not take any further trouble?—No, I was quite satisfied.

1353. (*Mr. Brakhan.*) Having a quantity of water exceeding 150,000 cubic feet per minute, the question arises whether you would get sufficient water in this large lake which is supposed to contain, when it is full, 209,000 million gallons?—I don't quite follow you. Do you mean whether the dam would be full or not?

1354. You say it was immaterial to you if the amount of 150,000 cubic feet was exceeded. I want to ask you now whether it is not material that we should know as to the possibility of keeping this enormous lake full of water seeing that you draw from it 1,000 million gallons per day for your turbines?—Yes, we draw for the turbines 150,000 cubic feet per minute, or for the thirty million scheme 111,000 cubic feet with the higher fall.

1355. Suppose you have filled this dam prior to starting work, then you draw off, in order to pump thirty million gallons, 1,000 million gallons a day from this lake and seeing there is a comparatively limited quantity of water in the Vaal even in the rainy season at a time when the river is not in flood, is it not a material question to inquire how far the flow you estimate will keep the dam full?—To answer your question precisely, sir, it would be necessary to take daily gaugings of the Vaal River.

1356. Is it not necessary for a scheme of this magnitude, which requires an expenditure of perhaps a couple of million pounds, to have exact gaugings?—Well, it would be advisable to get them if possible.

1357. I think, we ought to have them before us now.—It would mean living down at the Vaal River all the year round to do it.

1358. Then you stated at the previous examination that the price of coal on the West Rand is 40s. per ton?—Before the war.

1359. I may tell you coal is delivered at Krugersdorp ranging from 16s. to 20s.—Now?

1360. Now and before the war. We are speaking of Transvaal coal.—I understand Middelburg coal was over £2 before the war.

1361. No, sir, 18s. or 19s., and round coal 21s. or 22s.—Before the war?—Yes.

1362. (*Mr. Kitzinger.*) In your report of gaugings you give the quantity of water which you say is required for pumping. Can you tell us how you arrived at that calculation. I make it nearly 43 millions?—It is on account of the higher fall. You get 110 feet of effective fall with the dam at the foot of the falls. You require 110,000 cubic feet per minute to pump the thirty million gallons.

1363. (*Mr. Bell.*) Might I be permitted to put one question to the witness? It has been stated that the source of the Johannesburg water supply is the dolomite beds. I think you have some statement to make with regard to that?—Only Zuurbekom water is from the dolomite; the other sources of the Waterworks Co. are not connected with the dolomite. The dolomite water is hard; the other sources of supply are softer.

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TRANSVAAL CHAMBER OF MINES.

Mr. A. R. GOLDRING, called and examined:

Mr. A. R. Goldring. December 30, 1901.

1364. (*The Chairman.*) Mr. Goldring, you are the Secretary of the Chamber of Mines?—Yes, sir.

1365. You come prepared to make a statement to us with regard to the requirements of the Chamber of Mines?—Yes.

1366. Will you read it?

Statement of the Transvaal Chamber of Mines.

In arriving, as nearly as possible, at the present and prospective water requirements of the mines of the Witwatersrand, the Chamber has availed itself of the knowledge and experience of the leading mining engineers of Johannesburg; and though it has not been found possible to state with precision what the ultimate requirements will be, the information which the Chamber is able to submit, will, it is hoped, prove of assistance to the Commission.

The Chamber is of opinion that, considering the importance of the question, it is necessary to be prepared for years of exceptionally low rainfall and run-off; and that a supply of water for the mines from Randfontein to Geduld inclusive should be provided, capable of furnishing approximately 20 million gallons a day at a date about five years after normal conditions are restored, as from estimates made by the engineers of the various mining groups, it appears that in all probability there will then be about 17,000 stamps in operation in the district referred to above, or, say, 11,000 more stamps than were running previous to the war.

The data obtainable at present regarding the position at a period beyond five years from the restoration of normal working conditions are of so problematical a nature that it has been found difficult to arrive at an approximate figure for the final stamping power or water requirements. Nevertheless it is beyond doubt that there will be a considerable further development after the date named, as, if the economic conditions of the country are such as to facilitate the expansion of its main industry, it is probable that owing to the reduction of working expenses by improvements in appliances and otherwise ore bodies of lower grade than at present worked will be capable of being treated. The Chamber therefore is of opinion that under such conditions ultimately a supply of not less than 30 million gallons of water per day should be contemplated for the eventual total requirements of the Rand.

In the above estimates no allowance has been made for available water which might be encountered in new mining areas, the Chamber being informed that shafts which yield a material supply of water at present will later on in all probability show a decrease; and, in fact, several of the deep shafts to-day make very little water, and many crushing mines can be pointed out which pump less than 100,000 gallons a day.

Further it must be borne in mind that most water-rights on the down stream side of large dams already erected across the streams in the immediate vicinity of the mines under consideration can yield little, if any, water worth mentioning. Some of the large dams referred to above have not even filled during this war time when scarcely any demand has been made upon them.

The estimates include provision for the domestic wants of the white and native population of the mines and of the non-mining population of the villages within the mining area, but naturally not for the townships of Johannesburg, Krugersdorp, and Boksburg.

When any source of supply shall have been selected for final consideration and information is available which will enable calculations of cost to be made, the Chamber will be glad, should the Commission so desire, to submit a further statement dealing with this side of the question.

(Signed) A. R. GOLDRING,
Secretary.

Transvaal Chamber of Mines,
Johannesburg.

1367. (*The Chairman*). Mr. Goldring, you have one or two technical gentlemen here?—Messrs. Webb, Thomson, and Poore are here to answer any technical questions that the Commission or any parties interested may desire to ask with regard to the Chamber's statement, they having advised on the matter. And, if you wish it, Mr. Poore will first appear as a witness, and then the other witnesses can be called if you desire them.

(*The Chairman.*) Perhaps the best way would be that if any question is put to you which you think these gentlemen can better answer that question may stand over.

1368. (*Mr. Lance*, representing the Johannesburg Town Council.) In arriving at this 30 million gallons per day, can you give us any details?—It is estimated that a stamp will crush five tons, and take 400 gallons of new water per day.

(*The Chairman.*) That had better come from the technical witnesses.

1369. (*Mr. Lance.*) You would have an increase in the number of stamps to 16,000 or 17,000?—Yes, that is our estimate.

1370. The necessary consequence of that would be that there would be a very large addition to the population?—Presumably, but our statement does not deal with that. In our statement we try to supply information with regard to the water supply for mining requirements only.

1371. Can you give any data on which you based the increase of the number of stamps?—I think, if the Chairman will allow, a technical witness will answer that.

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1372. (*The Chairman.*) I have only one question that I will put to you, and that is as to the meaning of the last paragraph of your statement?—That is with regard to the cost.

1373. It is not clear to me what it means?—The idea of the Chamber in inserting that paragraph was that they should be in a position to lay before the Commission figures regarding what should be the approximate cost of the supply of water. Although they know the cost to various companies and can calculate it out, here they cannot make out their calculations until they know what source the Commission would recommend and then they would like to have an opportunity of estimating the cost so as to determine the charge that the companies, who will be the largest consumers, will have to pay. And they wish to be allowed to place that evidence before the Commission when the time comes.

1374. Do I undertand that the mines ask for special treatment on the ground of their being large consumers?—No, but they wish an opportunity of laying their views before the Commission on the question of cost, which will to a large extent fall on the mines, and for which the Chamber would be responsible.

1375. It comes to this that at a later period the cost at which this Board would supply water would be fixed, and it would be for the mines to decide whether they would come into the scheme or not?—Yes.

1376. In other words, they would assist us in arriving at the cost. We would be very glad of that assistance. Mr. A. R. Goldring. December 30, 1901.

1377. (*Mr. Thomson*, representing the Johannesburg Waterworks Company.) Does not this amount to a reservation on the part of the mines to supply themselves with water, and that they do not intend to commit themselves in any way to accept any scheme?——

1378. (*The Chairman.*) I think there is no occasion to put that question. You could not possibly expect the mines to commit themselves until they know where they are.

1379. (*Mr. Thomson.*) It is with reference to this last paragraph of your report. The intention of that I take it is this, that the Chamber of Mines would not commit themselves to any public scheme of water supply which might be framed, but left the question so that they may be free to supply themselves?—No. That paragraph carries nothing more than what the words naturally bear, that, when a source of supply is determined on, the Chamber, as representing the mines which would be large consumers, would like to be allowed to make calculations of cost with the idea of assisting the Commission; and the paragraph itself carries nothing more than its natural meaning, which is, I take it, what I have stated.

Mr. G. B. Poore, called and examined:

1380. (*The Chairman.*) Mr. Poore, will you tell us what your connection is with the Chamber of Mines?—I was a member of a committee asked to advise with regard to technical points on the water question. Mr. G. B. Poore. December 30, 1901.

1381. (*Mr. Lance*, representing the Johannesburg Town Council.) Can you tell us the number of gallons per stamp per day that you require for mining purposes?—Make-up water 400 gallons per ton crushed, and a stamp crushes five tons per day on the average.

1382. Is that what has been actually used so far?—That is the amount of water which the Engineers of the Committee agreed was required for make-up water per ton crushed. Some claim a trifle less, and I know of mines that use more according to their meters and methods of measuring the water on those mines.

1383. It is based on actual data gained here?—Yes.

1384. On what was the increase of stamps from 6,000 to 17,000 based?—The original committee which was asked to meet by the Secretary of the Chamber of Mines consisted of the engineers of the various groups of mines, and the calculations are based on the estimates that those engineers made.

(*The Chairman.*) I think we should take the examination of Mr. Webb and Mr. Poore jointly.

1385. (*Mr. Webb.*) I simply wanted to add that the different engineers of the different groups handed in what they expected their groups to be able to do in certain periods of three years and five years, eventually providing for no departure from the level of normal conditions and providing the working conditions are such as we expect and hope for, that the reduction in working expenses will be such as to facilitate the bringing in of large bodies of low-grade ore. But if the expected reduction in working expenses was prevented by any outside causes like increased taxation, it would throw out in a measure the calculations which have been made.

1386. (*Mr. Lance.*) Mr. Poore, in arriving at these calculations of what the Chamber required you have taken the total requirements and you have not allowed, have you, for any private source of supply in these 2,000 gallons per day per stamp?—That does not relate to any private source.

1387. Hitherto you have had to rely entirely on private sources?—Not absolutely.

1388. What other sources have you got?—For instance the Waterworks Co. have supplied water for some of the mines.

1389. Is not that a small amount?—A small amount.

1390. Hardly worth talking of?—Hardly worth talking of.

1391. Have you formed any idea what the amount obtained from private sources has been?—Yes. There are two sources of supply—the mines and private reservoirs. The total in one set of statistics showed that 467 gallons per ton crushed had been used.

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Mr. G. B. Poore. December 30, 1901.

1392. There is no reason why that should not continue, is there?—They were using actually more water than they could supply constantly.

1393. Yes, but this supply you speak of—do you think there is any reason to anticipate that it cannot be maintained?—Well, it was inadequate.

1394. Never mind whether it was inadequate or not. You told us you had a certain supply, and there is no reason to anticipate that that will cease?—That supply will continue.

1395. And as new shafts are sunk, won't that be increased by the ordinary mine water?—The new shafts which are being sunk have not as much water as the shafts on most of the mines which are called producing mines.

1396. But there would be something?—In all probability there would be something.

1397. So that you would have something in excess of 467 gallons per ton crushed on the new mines?—Yes.

1398. On what is that based? On what you were crushing before the war?—Yes.

1399. Can you give us the figures?—This 467 gallons per ton crushed was taken over seven mines. Of that quantity 166 gallons came from the mine and 301 gallons per ton crushed came from dams or outside sources.

1400. What is the total quantity? How much per day is the total?—Four hundred and sixty-seven gallons per ton crushed.

1401. All I want is a matter of fact. How many tons did you take into account?—That was on a tonnage of 1,908,000 tons.

1402. Was that the total tonnage being crushed per day by these seven mines?—In crushing 1,908,000 tons it was necessary to use 467 gallons make-up water for every ton crushed.

1403. Now this 1,908,000 was that the total tonnage crushed on the Rand?—No. That was only on the seven mines.

1404. When you spoke of getting this supply of 467 gallons, did you confine it to these seven mines?—No, that is the amount required per ton crushed on a great number of mines.

1405. What is the total quantity that you estimate you require?—The Engineers estimate that 400 gallons of new water is required for each ton crushed on new mines.

1406. Now I want to get at the total supply of water you had hitherto. I understood you to say it amounted to 467 gallons per ton crushed. Now in arriving at that you say that you take in only seven mines. Can't you give us the total water supply you had on the Rand from the mines and other sources?—It would be in the vicinity of twelve million gallons for make-up water per day.

1407. And that is allowed for in the quantity of water now stated to be required?—Yes.

1408. That would be twelve million gallons a day?—More or less.

1409. And that has been sufficient to run 6,000 stamps?—To run 6,000 stamps.

1410. Did you say that for 17,000 you will require thirty millions?—That is for more stamps.

1411. That is when you have got 17,000 stamps?—No.

1412. You want twenty million gallons furnished in addition to this mine water?—Yes, including water which we have from present dams.

1413. So that you want a total of thirty millions when you have got 17,000 stamps?—No, twenty millions.

1414. But you say you want twenty millions in addition to what you have already had?—We want the twenty millions for the difference between 6,000 and 17,000 stamps.

1415. So that for the 17,000 you want thirty millions?—You mean 17,000 increase?

1416. No. When you have got 17,000 stamps you want thirty million gallons of water?—No.

1417. You say you have 6,000 stamps current now, and for the increase you want twenty million gallons. Does not that mean that for the total you want 32 millions?

1418. (*The Chairman.*) The Chamber of Mines suggests that an ultimate supply of not less than thirty million gallons per day should be provided. That is based on a total of 17,000 stamps?—No, that is not based on a total of 17,000 stamps. There was a statement made that there would be more than 17,000 stamps.

1419. (*Mr. Lance.*) You have had 6,000 stamps running for which you had about twelve million gallons of water?—Yes.

1420. If you treble that amount, instead of 6,000 you can call the number of stamps 18,000, and the amount of water 36 million gallons?—The difference comes in in this manner. The present number of stamps is supplied with water from the mines to a great deal larger extent than these new mines can be expected to be. Formerly we had one shaft that gave us at least thirty million gallons a month. It is hardly fair to estimate that where you strike water in other shafts that they will give you that amount, and that you could supply quite a number of mines that would have been very short from such a source. It was an abnormal thing this yield of water in that district.

1421. But it is not a question of where the water comes from; we are talking now of the quantity. You have run 6,000 stamps on twelve million gallons a day?—Yes.

1422. (*The Chairman.*) Wouldn't you leave this point and we will perhaps have it cleared up at a subsequent meeting?

(*Mr. Lance.*) Very well.

1423. (*Mr. Thomson*, representing the Johannesburg Waterworks Company.) In this estimate of twenty million gallons for 11,000 extra stamps you do not take into consideration the use more than once of the same water?—Eleven thousand stamps would crush five tons

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per stamp per diem. Each and every ton crushed requires 400 gallons of new water. Therefore, the 11,000 new stamps would require twenty-two million gallons of new water per day.

1424. There are several available sites in close vicinity for dam purposes. Water that might be suitable for mining purposes might not be suitable for domestic purposes. At Roodepoort for instance there is a very large area where water could be conserved?—I do not think there are many areas there which would yield much water.

1425. You are aware of the waterworks below the Klip River hills that are being constructed?—Yes.

1426. From which a very large supply of water can be obtained?—Yes.

1427. What is the quantity you estimate you can obtain from that?—I do not know.

1428. It is in course of being carried out now?—Yes.

1429. Can you tell me the size of the pipes which are being laid down to convey that water to Johannesburg?—To which pipes do you refer?

1430. The pipes from the borehole near Klip River and Vierfontein.—I do not know which pipes you refer to.

(*The Chairman.*) Is not that irrelevant?

1431. If the mines are in a position, or are in the very act of supplying their own water for some of the principal groups, it will be unnecessary for the Water Board or whatever board will be constituted to supply such a large quantity, seeing the mines are taking steps to supply themselves?—Need I reply to that question?

(*The Chairman.*) Not unless you like.

(*Witness.*) I would rather not answer that question.

1432. (*Mr. Thomson.*) You can tell me this, that it is within your knowledge that a number of mines in the vicinity of Johannesburg are making arrangements for the supply of their own water and are capable of supplying their own water?—I do not know that they are capable of supplying their own water. I know that they have been making arrangements for water supplies.

1433. (*The Chairman.*) As I understand the matter, the statement that has been prepared indicates the amount of water that the mines would ask us to provide should they come into this general scheme?—Yes, sir.

1434. Then we may take it from the figures given that twenty million gallons would be the amount which they would take from us in five years' time?—Yes.

1435. We are assuming that the mines are as capable of estimating their requirements as the Town Council; and if the mines say "We are prepared to take that amount from you," the mines are sufficiently solvent to carry out their guarantee, and therefore we should not have any great anxiety in considering how you arrived at these figures, unless we find our sources of supply are unequal to the demands made upon them, in which case we should like to know that you have exhausted every possible source before you have come to us. Do you know if you contemplate going on with the proposal to which you have referred?—The water will have to be had from some source.

1436. The mines are satisfied that 20 millions will have to be got outside the water they now obtain from schemes in operation?—If the economic conditions are what they should be water will have to be had from some source.

1437. I believe that hitherto the mines have scratched for water where they could?—Yes.

1438. But these scratchings are exhausted, and there is no possibility of the mines getting a supply unless they go further a-field?—Almost every available source has been used up in the immediate vicinity of the mines.

1439. It is a question I ought perhaps to ask Mr. Goldring, but perhaps you could answer it. In these figures do you include Germiston?—There were three towns left out—Johannesburg, Krugersdorp, and Boksburg.

1440. What about Germiston?—It is taken in.

1441. What has been the experience of mines using water from the dolomite in their boilers as compared with water from the Vaal River?—The dolomite waters have been used to such a small extent that whether the water gave a good result or a bad result I cannot tell.

1442. You have not used dolomite water by itself in your boilers?—Not to my knowledge.

1443. It has always been mixed with surface water, so that the result escaped your notice?—Yes, sir. All the water that I know of as coming from the dolomite has a permanent hardness of about ten degrees, and in such cases a water softening apparatus should be used.

1444. So that you are in a position to say that the mines have not used water from the dolomite?—Not to any extent.

1445. Have you any idea what will happen if they do use it? Are you apprehensive of these results to boilers which have been suggested?—I do not think it would do much harm. It might be necessary, if the water is hard in future, to get a softening apparatus in connection with all boiler plant in which dolomite water is used.

1446. Which is not a very expensive business when used on a large scale?—It would depend on the degree of hardness of the water what the expense would be.

1447. That is a question that some one on behalf of the Chamber of Mines ought to be able to speak on definitely. Do you say you cannot employ the water from the dolomite on account of the hardness?—I should say you can employ it.

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Mr. G. B. Poore.

December 30, 1901.

1448. And the expense of the softening would not be so great as to lead you to say that you ought to go to the Vaal for your water?—I should say it would add 10 to 15 per cent. to the cost of boiler plants to add softening apparatus. Dolomite water would be beneficial in milling operations. We have to add lime to the water in several of the reduction processes.

1449. There you have a counter-balancing advantage?—No, I do not think the advantage you would have in using hard water would be worth mentioning. It would certainly not be a disadvantage.

1450. You are sufficiently clear in your own mind to make it unnecessary for me to ask the Chamber of Mines to give us a statement on the subject?—There is no objection to your doing so. I think I have given a correct answer.

1451. Your answer in effect is that it would increase the cost of a boiler plant 10 or 15 per cent., which I suppose would be a pretty large item?—Yes, I think it is an item.

1452. But spread over 20 million gallons it would not amount to very much?—Only a small portion of the water is used in the boilers.

1453. It would not average very much per thousand gallons? You do not think it an important point?—No.

1454. (*Mr. St. John Carr.*) Does the 400 gallons per ton per day, which would be required for the mines, include all the water for domestic purposes on the mines?—Yes.

1455. Then this 15 per cent. which would be added to the cost of the boiler plant—that would merely be a capital outlay?—That portion of the plant would have to be maintained.

1456. (*Mr. Quinn.*) If there is a prospect of the stamping power being increased from 6,000 to 17,000, don't you think that that would necessarily mean a very large increase in the white population?—It would probably mean quite an increase in the mining areas. The average now is about two white workmen per stamp.

1457. In addition to that, the town is supported by the mines, and, consequently, if you are going to increase your stamping power from 6,000 to 17,000, the town if it does not increase at a proportionate rate must still increase materially?—It must do so.

(*The Chairman.*) The Commission would be obliged if by the next sitting the representatives of the Chamber of Mines would give a written statement showing the calculations on which the requirements of the mines are based.

(*Mr. Webb.*) I can give it to you now if you wish.

(*The Chairman.*) I think if we have it in writing it would be sufficient.

The Commission then adjourned.

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WITWATERSRAND WATER SUPPLY COMMISSION.

MINUTES OF EVIDENCE.

FIFTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

MONDAY, 13TH JANUARY, 1902.

Present:

W. ST JOHN CARR, ESQ. (ACTING CHAIRMAN).

A. BRAKHAN, ESQ.,
B. KITZINGER, ESQ.,
G. ROULIOT, ESQ.,
W. McCALLUM, ESQ.,
J. W. QUINN, ESQ.,

G. CRAIG SELLAR, ESQ., SECRETARY.

1458. (*Mr. St. John Carr.*) The Government have notified me to take the chair in the absence of the Chairman. We will now hear Mr. Webb. There was a statement, Mr. Webb, that you said you would prepare. Will you kindly read that now?
(*Mr. Webb.*) Yes.

TRANSVAAL CHAMBER OF MINES (*Continued*).

Mr. H. H. WEBB then read the following statement:—

Mr. H. H. Webb. January 13, 1902.

In November last a meeting of Engineers representing the several groups of Mines on the Rand was convened to go into the matter of the Water Supply for the Mining Industry. In order to arrive at a fair conclusion it was necessary to form an estimate of the number of stamps which would be running within a reasonable time after normal conditions were restored, allowing a sufficient period for a permanent reduction of working expenses and the carrying out of the development and equipment of those newer mines which had encountered, or were nearing, the reef. Low grade bodies of ore, which would become available and add considerably to the amount of ore which could be treated, were taken into account on the assumption that the benefit to be derived from reduced working expenses would enable these bodies to be treated.

Statements were handed in showing the number of stamps each group of mines would have running in five years' time, after the restoration of normal conditions, and similar estimates were made for unrepresented holdings. The total number was estimated at 17,000 stamps, 5 tons per diem per stamp being taken as the duty of these.

Statements were also submitted showing the amount of water which was available for the use of the mines during the months previous to the war, the yearly storage in reservoirs or dams and the quantity of water pumped from each mine, and the excess or shortage of water in gallons per 24 hours as regards requirements.

It was decided that a loss of 400 gallons per ton crushed was a fair estimate of the amount of make up water which would be required by a milling property. This estimate was based on data collected on several mines previous to the war, as for instance, during the year 1898 from data furnished by Mr. Webber, the General Manager of the Rand Mines Group. The Geldenhuis Deep, Rose Deep, Crown Deep, Jumpers Deep, Nourse Deep and Glen Deep used an average of 485 gallons of make up water per ton of ore milled, of this 183 gallons were from the mine and 302 gallons from outside sources. Of these mines Mr. Webber considers that the Geldenhuis Deep was working under the best conditions for the economical use of water. This mine received from its shafts 101 gallons and bought 335 gallons per ton crushed.

During the year from 1st October, 1898, to 30th September, 1899, Mr. G. B. Poore, of Messrs. Eckstein & Co., collected data on the consumption of water by the Crown Deep, Geldenhuis Deep, Rose Deep, Glen Deep, Jumpers Deep, Nourse Deep and Village Main Reef. These mines showed an average consumption from outside sources of 301 gallons per ton crushed and they produced from their own shafts 166 gallons per ton crushed, giving a total of 467 gallons of make up water per ton crushed.

It will be noted that while over different periods of time both Mr. Webber's and Mr. Poore's statistics are remarkably close as to water purchased, 302 gallons in one

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Mr. H. H. Webb. January 13, 1902.

case and 301 in the other, per ton crushed, the total differences of water consumed being, one might say, entirely in the water from shafts, 183 and 166 gallons per ton, or a difference of 17 gallons per ton. This difference of shaft water may have been caused in a measure by the difference of rainfall in the two years. The months of January, February and March of 1898 being greater than the same months of 1899.

During the months of 1899 previous to the war the Robinson Deep consumed an average of 130 gallons per ton crushed from the mine and from outside sources an average of 297 gallons, or a total of 427 gallons per ton crushed.

The management of the Simmer and Jack Proprietary Mines, Ltd., estimate their consumption at 222 gallons of shaft water per ton and 193 gallons per ton from outside sources, making a total of 415 gallons per ton crushed, domestic water not included.

The opinion was formed that, with extra precautions as regards the economical use of water, 400 gallons of make up water per ton crushed would be sufficient, this included the domestic requirements of the inhabitants of the property.

The average quantity of water produced by 19 mines, from statistics kept by the late Major Seymour, was 136,069 gallons per mine in 24 hours.

It was estimated that the average developed mine on the Rand could be relied on to produce 100,000 gallons per day which would give for a 200 stamp mill 100 gallons of the 400 gallons of make up water required, but many of the mines produced much less than this amount and the water coming from nearly all of the deep shafts now being sunk on the Rand shows a tendency to decrease and appears to be nearly all surface water as shown by the following examples:—

The Robinson Deep pumps from its shafts about 88,000 gallons per 24 hours, 60,000 gallons of these are from a point about 166 feet down the shafts. The lowest level in the mine is 2,500 feet below the surface and is comparatively dry.

The Milner shaft at the South Geldenhuis Deep, which is 2,746 feet deep, made in 1899 only 3,150 gallons per 24 hours, the first flow of water coming from a point about 175 feet down the shaft and the second flow about 1,200 feet down. Below this point the shaft is comparatively dry.

The Rhodes shaft of the South Geldenhuis Deep, which has attained a depth of 2,015 feet, produced about 28,820 gallons in 24 hours, 28,280 gallons being lifted from the 500 foot station and 540 gallons from about 1,800 feet down the shaft.

The Howard Shaft of the Simmer and Jack West, which is 3,409 feet deep, produced 11,500 gallons at about 250 feet below the surface and only 320 gallons at 1,300 feet down the shaft per 24 hours; below this point the shaft is dry.

The Catlin Shaft of the Jupiter Gold Mining Co., which is 3,752 feet in depth, gives 4,608 gallons at 130 feet from the surface and 1,840 gallons at the 1,500 foot mark per 24 hours; below this point the shaft is dry.

The West Shaft of the Witwatersrand Deep with a depth of 1,500 feet produces about 5,000 gallons per day, the greater portion from near the surface.

It is to be expected that there will be in these some increase of water as development work progresses, but present workings in the deep shafts of the Rand seem to point to a very material decrease in the amount of water to be obtained from the deeper mines which will make up a large proportion of the additional stamps.

It must also be borne in mind that under the new regime, taking into consideration the anticipated benefits to be derived, it is probable many of the families of employees hitherto living abroad will reside on the Rand and thus increase the water required for domestic consumption. And from the fact that many dams on these fields have not filled during the war, when no demands were made on them, it was considered improbable that any large amount of water could be conserved by building more dams.

In the case of villages along the line of reefs it was assumed that they would continue to receive the same quantity of water for their domestic use in the future as they had in the past, and from the same sources, and that the additional inhabitants, or increased population in these villages would be made up almost entirely of mine employees and their families.

The allowance for the domestic use of mine employees and their families was taken into account in the estimate of 400 gallons of make up water.

The allowance per head of white and black population on the mines was placed at about 6 gallons per head and this was arrived at from the following data:—

1. From figures furnished by Mr. Johns at the Ferreira Mine during the months of May, June, July, and August of 1899, of water bought for domestic purposes by meter, the consumption per diem for whites averaged 3·4 gallons and for blacks 2·7 gallons, exclusive of water used in gardens or for the baths of white inhabitants.

2. The Crown Reef during July, August and September, 1899, consumed an average, according to meter measurement, of 3,166 gallons per day, or 1·364 gallons of domestic water per inhabitant.

3. The Bonanza Mine during the months of July, August, September, October, November and December, 1901, consumed an average (meter measurment) of 3·69 gallons per inhabitant for domestic purposes.

4. The City and Suburban, having an ample supply of water from a well controlled by the Company, consumed for domestic purposes before the war about 10 gallons per day per inhabitant.

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The Simmer and Jack Proprietary Mines obtained their domestic water, before the war, from their own wells, and consumed an average of 9·4 gallons per inhabitant.

It will be noticed that when water is abundant the consumption increases.

As regards the domestic consumption of water, I beg to quote the following statistics of certain large cities of Great Britain, these include sewerage which, of course, we have not considered with regard to our mines.

This table is taken from "The Principles of Waterworks Engineering," by J. H. Tudsbery Turner and A. W. Brightmore, published in 1893, page 415.

Statement of Water Supply of certain towns in Great Britain.

Town.	Estimated Population Supplied.	Supply in Imperial gallons per head per day.	Nature of the Source of Supply.
London	5,240,000	33	Rivers, springs, and wells.
Manchester	950,900	22	Catchment.
Glasgow	850,000	50	"
Liverpool	770,000	26	Catchment & wells.
Birmingham	640,000	22	Rivers and wells.
Bradford	400,000	25	Catchment.
Edinburgh	350,000	40	"
Nottingham	240,000	18	Wells.
Brighton	180,000	33	"
St. Helen's	70,000	20	"
Bath	60,000	20	Springs.
Torquay	45,000	30	"
Chester	40,000	28	River.
Exeter	40,000	38	"
Scarborough	30,000	23	Springs and wells.
Leamington	25,000	19	Wells.

Report of Royal Commission (1892) on the Water Supply of the Metropolis—London, 1893. Hastings "Waterworks Statistics,"—London, 1892. De Rance, "The Water Supply of England and Wales,"—London, 1882.

It will be noticed that Nottingham, with 240,000 inhabitants, consumes but 18 gallons per head; Bath and St. Helen's 20 gallons per head; Manchester and Birmingham 22 gallons each per head.

DOLOMITE WATER.

In the report of the Transvaal Concessions Commission, dated 19th April, 1901, page 290, I find recorded a number of analyses made as far back as 1895 on several samples of dolomite water. Analyses were also made in 1899 by Dr. Loevy on water from Oliphant's Vlei which is also Dolomite Water. The chemists report on all these samples as being excellent for domestic purposes and for general use. The hardness varies from 5·2 to 11, and for boiler purposes the purifying adjunct to the boiler plant which, for the ordinary steaming plant is estimated at about 10 per cent., as shown by the following:—

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The pumping plant at Oliphant's Vlei is at present fitted with two boilers; these are a part of a plant of six boilers which will cost £5,940.

There was purchased, for softening the water for this boiler plant, an improved Patent Water Softening and Purifying Apparatus from Messrs. Mather & Platt, which will cost, when erected, in the neighbourhood of £600, or say ten per cent. of the total cost of the six erected boilers.

(Signed) H. H. WEBB, M.I.C.E.

11th January, 1902.

1459. (*The Acting Chairman.*) This is your statement; will you kindly put that in?—Yes.

(*Mr. Lance.*) I should like to say that I have had no access to this statement previously and it is quite impossible to cross-examine on an elaborate statement like that at a moment's notice.

(*The Acting Chairman.*) You would like to have a later opportunity of cross-examining?

(*Mr. Lance.*) Yes; I should like to have the statement and go carefully through it. This might have been obviated had I had a copy supplied me.

(*The Acting Chairman.*) A copy of the statement will be furnished you.

(*Mr. Thomson.*) I also would like to have a copy of the statement.

(*Mr. Dumat.*) I also would like to have a copy.

(*The Acting Chairman.*) You shall have it.

(*The Acting Chairman.*) Mr. Thomson, we will now hear the evidence of Mr. Stewart.

JOHANNESBURG WATERWORKS COMPANY.

Mr. THOMAS STEWART, called and examined:

1460. (*Mr. Thomson*, representing the Johannesburg Waterworks Company.) What are your qualifications, Mr. Stewart?—I am a member of the Council of the Institution of Civil Engineers, and a Fellow of the Geological Society of London.

1461. What experience have you had in your profession?—After the termination of my pupilage I was engaged as Assistant for five years in the Glasgow Corporation Waterworks, thereafter Assistant to Mr. Wolfe Barry (now Sir John Wolfe Barry, K.C.B.) I was appointed Assistant to the Hydraulic Engineer to the Cape Colony by the Crown Agents in 1882. I was employed in the department of the Hydraulic Engineer for the three years provided for in the agreement, and also remained in this department for four months afterwards. While in the service of the Government I was engaged on investigations relating to irrigation and town water supplies, and these investigations included the making of surveys in various parts of the Cape

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Colony. I also took charge of the department for six months while the Hydraulic Engineer to the Colony was on leave of absence. Since December, 1896, I have been engaged in private practice, and during the fifteen years which have elapsed since 1886 I have been engineer for nearly all the waterworks in the Cape Colony, or I have been brought into connection with them for engineering reasons. At present I am constructing a large storage reservoir for Cape Town, waterworks for Oudtshoorn, drainage works for Wynberg, and various works involving altogether an expenditure of over £400,000. In 1889 I made an investigation and designed a scheme of waterworks for Bloemfontein. Since then I have designed alternative schemes for the same town. One of these, known as the Sannah Post Scheme, has lately been carried out under my direction as engineer-in-chief. My connection with the Witwatersrand began in 1889, when I visited Johannesburg to make some geological investigations. In 1892 I again visited Johannesburg, this time at the request of the Johannesburg Waterworks Company, and shortly afterwards I designed a scheme for bringing water from the Vaal River, near where the Klip River joins it. In 1896 I was engaged as Consulting Engineer by the Waterworks Company to advise them on certain matters relating to their waterworks, and I afterwards directed the making of surveys for bringing water from Steenkopjes and from Zuurbekom. The duties of Resident Engineer on the Zuurbekom works were performed first by Mr. J. H. Whieldon, Associate Member of the Institution of Civil Engineers, and latterly by Mr. Monier Williams, Member of the Institution of Civil Engineers. Briefly, since 1896, I have been Consulting Engineer to the Company in regard to the maintenance of existing works, and engineer-in-chief for all new works. I have, in these capacities, after consultation with the Company, given directions for the taking of gaugings of streams and for the making of surveys and other investigations. In 1898 the Vierfontein Syndicate engaged me to make an examination of all sources within fifty miles of Johannesburg, with a view of securing a large supply of water for the use of the mines. This investigation continued up to the beginning of the war (October, 1899). It included the making of flying surveys, the taking of gaugings of all likely sources, and an examination of the geology of the district in so far as it had a bearing on the water supply. These investigations, in my opinion, cover the whole area over which it is necessary to go in considering the question of providing a large supply of water for the Witwatersrand. It has not been possible for various reasons (*e.g.*, absence of right to enter upon ground, expense, etc.), to get as much data as it is desirable to have, but I think the results are sufficient to enable anyone thoroughly acquainted with the physical conditions of the country and the requirements of the Witwatersrand to frame a scheme or schemes which will give an ample supply of water both for the town and for the mines.

1462. We will go next into the consumption of water, but before doing so, I would like you to define what you mean by the term "domestic water"?—The term "water for domestic consumption" includes, as I will show hereafter, water used for municipal purposes, such as street watering, fire extinguishing, washing out courts and alleys, public baths, wash houses, supply of public horse troughs and urinals, and practically everything like that.

1463. A great deal of evidence has been led on the consumption of water per head. In this connection can you lay down any hard and fast rule for determining the quantity per head?—No, the quantity per head depends upon so many circumstances that it is very seldom that the conditions of one town are applicable to the conditions of another town. Where water is cheap, the rate of consumption per head of the population is high, as it does not pay to take elaborate precautions to prevent waste. Moreover, where the supply is abundant it is frequently found that towns prefer to expend money on new works for rendering the supply available to the inhabitants instead of taking measures for restricting the rate of consumption per head. For example: take the town of Buffalo, which, using 310 gallons per head, proposes to double its existing water supply instead of taking measures to prevent waste. Then much depends upon whether water closets are largely in vogue and on the class of water fittings in use. Glasgow is a striking example of what I have just stated. The supply is abundant and cheap, and the number of baths, water closets, and fittings per head of the population, is probably greater than in any other town in the United Kingdom, consequently the consumption of water per head is very great, viz., about fifty gallons per day, including water used for trade purposes. Whereas, in various towns in England, the water is scarce, or dear, or both, precautions are taken to prevent waste, with the result that a much less rate of consumption per head suffices. The following is a table showing the population and consumption of water per head in a number of towns in England in 1897:—

Town.	Population.	Consumption. Gals. per day.
Worcester ...	45,000	43
Wigan	60,000	20
Plymouth ...	98,000	59
Swansea ...	100,000	35
Middlesborough	187,000	61
Sheffield ...	415,000	21
Manchester ...	849,000	40
Average of 36 towns...	...	33

These rates include the quantity of water used for trade purposes. I might supply tables giving the quantity of water supplied to various towns in Europe and in India and elsewhere, but as I said before, while they are interesting I doubt if many of

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them are applicable to Johannesburg. That the supply can be reduced without injuriously affecting the consumer has been proved in every instance where proper steps have been taken to prevent waste, for example in Glasgow, Liverpool, London, etc. As I was connected with the measures taken to prevent waste in certain districts of Glasgow containing a population of 80,000 persons, I give some of the results taken from a paper prepared by me and printed in the minutes of the Proceedings of Civil Engineers. In one district containing about 3,000 persons the consumption at the commencement of the investigation was found to be 60 gallons per head, this was reduced to 34 gallons. In another district containing 730 persons, the consumption was found to be 146 gallons per head, this was reduced to 60 gallons. In a third district containing 1,560 persons, the consumption was found to be 14·3 gallons per head; this was reduced to 13·3 gallons. I may state that this district contained a poor class of population. Over the whole area under inspection, the consumption was reduced from 49 gallons per head to 32 gallons, including water consumed for trade purposes. In London the measures taken to prevent waste were equally striking. For instance, in some portions of the district supplied by the Chelsea Company reductions were about fifty per cent., from 39·5 to 19·5, and from 30·3 to 15·5 gallons per head. This reduction was brought about by effective supervision of the waste, due to effective fittings. (Full particulars of this at much greater length will be found in the Report of the Royal Commission on the London Water Supply, 1899.) As reference has been made to the high rate of consumption in American cities, I give the following table, which is taken from "Water Supply Engineering," by Folwell, a writer on American Waterworks.

Population and Consumption of water per head in various Cities of the United States. "Water Supply Engineering," Folwell, p. 36.

City.	1890. Population.	1890. Gals. per head.	1897. Population.	1897. Gals. per head.
New York ...	1,515,301	85	1,700,000	112
Chicago ...	1,099,850	127		
Philadelphia ...	1,046,964	132	1,385,734	215
Brooklyn ...	853,945	67		80
Boston	527,630	80		
St. Louis ...	451,770	78		
Cincinnati ...	296,908	115		
Cleveland ...	261,353	106		
Detroit	205,876	155	279,107	125
Providence ...	132,145	46		
Fall River ...	74,308	28		36
Salem	30,801	69		
Wilmington, N.C.	20,056	22		
San Jose, Cal. ...	18,060	194		
Keokuk, Ia. ...	14,101	78		
Brookline, Mass.	12,103	73		
Baton Rouge, La.	10,478	19		
Nanticoke, Pa....	10,044	199		

The rate in most American cities is exceedingly high. This is chiefly due to the want of strict regulations, a fact which is admitted by the leading waterworks engineers. Folwell, in his book already quoted, says: "Millions of dollars are being spent by many of our larger cities to so increase their supply that two-thirds of it may be wasted." The instances of the rate of consumption which I have given show the variations which occur, and clearly indicate the difficulty of stating the exact supply per head which may be consumed in Johannesburg unless it is clearly understood that the management of the works will include measures for the prevention of waste.

1464. After giving these different statistics and stating that each town must be judged by itself; what, in your opinion, would be a sufficient quantity for domestic purposes in a place like Johannesburg?—I consider that thirty gallons per head is ample for domestic purposes, and I consider that any surplus over thirty gallons per head per day is sheer waste, and will only make the sewage question more difficult to deal with.

1465. You do not advocate any increase of that quantity without a sewage scheme being first in operation?—I consider that thirty gallons per head per day should be sufficient even with a sewage scheme

1466 And in your opinion without a sewage scheme it is advisable to conserve the water as much as possible?—I think twenty to twenty-five gallons per head per day a very ample supply until there are sewerage works in operation.

1467. Mr. Andrews, in his evidence, stated that he considered sixty gallons for Europeans, and forty gallons for natives is a supply which should be used. Is that excessive?—I certainly think it excessive and if supplied before the sewage scheme is inaugurated the surplus might enable gondolas to be sailed in Commissioner Street.

1468. Can you arrive at any estimate of the total quantity of water that would be required for Johannesburg?—The total quantity of water that would be required for Johannesburg is a very difficult question indeed to tackle. Various estimates have been given in some of the evidence as to what the population is at present and what it is expected to be in five years' time.

1469. It has been estimated that the population will increase from 100,000 to 200,000 within the next five years. Do you agree with that estimate?—I cannot agree with the latter estimate, but there may be reliable estimates as to the former. Any estimate as to what it is likely to be five years hence cannot be expected to be other than a guess. I fully believe there will be an immense increase in the population of the Witwatersrand, but there are many obstacles to its being 200,000 within five years from now.

1470. Two hundred thousand?—Yes; 200,000.

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1471. Assuming that these figures are correct which have been given, or these guesses are correct, that the population will be increased to 200,000, what would you give as a sufficient consumption of water for such a population, say for a population of 100,000 whites?—I estimate the requirements for domestic purposes in the near future: For whites, 100,000 at 20 gallons per head per day, 2,000,000 gallons, and for coloured, which I have taken at 40,000, at six gallons per head per day, 240,000 gallons per day.

1472. You heard the evidence given by Mr. Webb a few minutes ago, are you inclined to agree with his figures rather than with Mr. Andrews'?—From my experience of natives six gallons per head for them is a very liberal supply indeed. I may say that in the schemes which I have been designing elsewhere I take it that natives are well supplied if they get a third of what is supplied to the white population.

1473. On that basis of 100,000 whites and 40,000 coloured it would give a total consumption of 2,240,000 gallons per day?—Yes. But I have to point out that I take 40,000 natives instead of 60,000, the number estimated by Mr. Andrews.

1474. Now the present consumption of Johannesburg, or rather that immediately preceding the war, amounted to under 1,000,000 gallons per day?—Yes.

1475. Is it possible to use this large increase under the same conditions?—Yes, provided they had the necessary fittings. The large increase could not be consumed at present simply because the houses are not supplied with the necessary fittings and it would take some time to put in proper fittings.

1476. What do you reckon the consumption would be if the population were doubled and the sewage scheme was in force?—For whites, assuming there were 200,000, and assuming 30 gallons per head, 6,000,000 gallons per day, and for coloured persons, assuming there were 80,000 population, at 10 gallons (a very large amount per head per day) 800,000, in all 6,800,000 gallons per day. I may mention that I have not included any allowance for gardens in this estimate.

(*Mr. Thomson.*) In the town of Johannesburg itself there are not many gardens.

1477. Evidence has also been led as to the advisability or non-advisability in using meters in the supply of water. What is your opinion?—I consider that meters should be compulsory in cases of hotels, clubs, dwelling houses with more than 100 square yards of garden ground, soda water manufactories, breweries, etc., but in the cases of houses without garden ground, and where the water is entirely used within the house, meters may be dispensed with. I may state that this system is actually in use at Wynberg, Cape Colony.

1478. In this case I presume a fixed charge is made for the houses where the water is laid on?—Yes, a minimum charge. The houses pay so much a year according to their valuation. If I remember rightly a house worth £400 pays £2 a year and there is an increase in the charge according to the value of the house.

1479. Before leaving the question of the estimated increase in the population, can you give us any statement or information about similar estimates, where one estimate was formed by the Council and another formed by the persons who supplied the water?—In the case of the Balfour Commission on the London Water Supply in 1893, the Water Companies were asked to estimate the population supplied by them in 1891, and to give a forecast as to what it would be in 1931, that is 40 years ahead. They did so, giving 5,490,471 as the population supplied in 1891 and 8,526,554 as the population which would have to be supplied in 1931. The calculations were not accepted by the Commission who estimated the population in 1931 at about 12 millions. The rate of increase since has, however, corroborated the calculations of the Waterworks Companies instead of those of the Commission, proving in this case that the Water Companies were in rather a better position to estimate the increase in the population than the London Commission. The Commission of 1899 adhere, however, to the estimate of the Commission of 1893.

1480. Can you tell us anything about the past water supply of Johannesburg?—There have been several difficulties connected with the water supply of Johannesburg in the past. These are chiefly (1) want of information as to rainfall, the run-off from catchment areas, the yield and permanence of springs and rivers, and generally, the capacity of the proposed sources to supply the quantity of water required. When I was first called in by the Company in 1893 to advise them on certain matters, including the possibility of obtaining a supply of water from the Vaal River, and from various other sources, the Company had no rain gauges in use, nor, in fact, were there any reliable statistics available regarding the water supply of the Witwatersrand. Rainfall observations were begun by the Company during that year, and they have been continued ever since. Other observations are also now available, consequently a fair idea can be formed of the amount and distribution of the rainfall, and blunders in the making of storage reservoirs which will never fill, can now be avoided. (2) Up to 1896 the rate of increase in the population of the town was so rapid that it was not possible to keep pace with its requirements, except at the risk of constructing works which would not prove to be remunerative for many years to come, probably not at all if a depression took place in the gold mining industry, or if the conditions of working become radically changed. (3) The directions in which the extensions of the town were likely to take place, could not be foretold, as they were often governed by circumstances which had little to do with the suitability of a particular locality for residential or industrial purposes, conse-

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quently these localities suffered for want of water for a time after buildings had been erected, owing to there being no means for supplying it, even if the water was available. As bearing on that I might refer to a statement by Shadwell: "It is well known that the tide of population sets now in this direction, and now in that, in obedience to laws the action of which cannot be foreseen or controlled." (The London Water Supply, Shadwell, p. 42.) (4) The difficulty of obtaining powers from the Government to enable the Company to promote a scheme for taking water from one catchment area to another. (5) The elevation of Johannesburg relative to the surrounding country, and its distance from a suitable source are so great that any works having for their object the bringing in of a supply of water must be framed on a large scale, and consequently they must be expensive. As the inhabitants of Johannesburg are not bound to take water from the Company, I doubt whether investors would be found ready to put money into a large scheme where the sale of water was likely to be doubtful.

1481. From that you mean to say that where a certain quantity or a large quantity of water was guaranteed to be taken, it would be possible to supply the water at a much cheaper rate?—Yes.

1482. What were the sources of supply in 1896?—When I became permanently connected with the Company in 1896 as their Consulting Engineer all the water supplied was drawn from local sources, viz., from Doornfontein and Weltevreden. The supply from these sources in dry seasons seldom exceeded 600,000 gallons per day, which was found to be quite insufficient for the requirements of the town. The Company, therefore, set about obtaining an increased supply. For about eight months in the year the supply was in excess of 600,000 gallons, and sometimes reached about 900,000 gallons.

1483. In consequence of this occasional shortness, the Waterworks Company, I believe, undertook investigations?—Yes, they set about examining the country.

1484. Have you any particulars of the rainfall?—Yes, I hand in a statement* showing the monthly rainfall for the years 1897, 1898, 1899, 1900, and 1901, as observed at the Pumping Stations of the Johannesburg Waterworks Company. As regarded the rainfall, it appeared that the yearly amount varied from 20 to 40 inches. The variation shews that although the rainfall was abundant in some years, yet when the rainfall was small the droughts were severe. From the statement handed in it will be seen that the highest rainfall observed in any one month was in January, 1900—nine inches, which was observed at No. 1 Station. This however was exceptional as only on three other occasions did the rainfall registered at that station exceed seven inches. This was in the month of January, 1897 and 1898, and in November, 1900. The minimum rainfall for any one year during this period was 24·06 inches which occurred in 1897 and the maximum 31·94 inches, both results being at No. 1 station. However interesting the amounts for different years may be, they do not enable us to judge of the effect on the water supply unless the distribution throughout the whole year is taken into account. The dry months of the year are generally June, July, August and September, but it not infrequently happens—as in 1900—that although the amount for the whole year amounted to 31·94 inches, the eight months—March to October inclusive—only contributed 7·5 inches or about a quarter of the total. Such conditions necessitate, of course, in the case of storage reservoirs a large surplus of water to be kept in store to meet the vagaries in the distribution of the rainfall throughout the year.

1485. Up to this time the bulk of the water used was surface water?—No, the Company had begun getting water from bore-holes at Natal Spruit some time before.

1486. A portion of the water anyway?—Yes.

1487. And you considered this might be improved upon?—Yes, as the buildings were getting more numerous around the sources it appeared to me that in order to avoid pollution it was desirable to go further afield and I gave it as my opinion that water collected from the surface near Johannesburg would certainly be polluted. Since that date my conclusions have been strengthened by subsequent observations, in fact I know of no catchment area or stream of sufficient magnitude for the needs of Johannesburg within a radius of 30 miles of the town where potable water of suitable quality can be obtained.

1488. In consequence of this the Company were endeavouring to acquire additional sources for the supply of pure water and they purchased the farm Steenkopjes and Wolvekrans?—Yes, that was before I was called in.

1489. Did you examine this source at Steenkopjes?—Yes. In accordance with the instructions of the Company I made a thorough examination of the source. A line for a pipe track was laid out by me and a survey of the same was subsequently made under my directions by a very competent surveyor and several assistants.

1490. While this was proceeding the Company acquired another source?—Yes, they acquired Zuurbekom.

1491. Did you examine this?—Yes, I examined this also. I gave it as my opinion that at least 1,000,000 gallons per day could be obtained, that being the amount which the Company considered they would be justified in attempting to secure.

1492. That was in excess of the average consumption at that time?—Yes.

* See Appendix G. 1.

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1493. Did you make any recommendations?—Yes, I recommended in view of an increase in the consumption of water in Johannesburg within some years after the benefits of the Zuurbekom water were known, that provision should be made for carrying two million gallons per day to Paarlshoop, an intermediate pumping station on the Weltevreden-Johannesburg pipe track. The Company decided to take up the scheme on that basis and the necessary surveys were made.

1494. Both these supplies are in the dolomite formation?—Yes, it extends as a matter of fact from Zuurbekom to Steenkopjes.

1495. Can you give us a general description?—Yes, the Witwatersrand forms the watershed between the district which drains north to the Crocodile River and that which drains north to the Vaal River. At its western end it slopes down towards a rolling plateau formed by dolomite, and at its eastern end it loses itself in a district of somewhat similar character. The highest point with which I am concerned is that on which the service reservoir is placed. The top water level of this is 5,967 feet above the sea. This height is based on a datum level of Vereeniging Railway Bridge. The dolomite formation extends entirely round the Witwatersrand except at its eastern end, but for the present purpose we are not concerned with that portion of the formation to the north. To the south the formation is not largely in evidence at the surface but westwards it covers a large area of country, spreading towards Potchefstroom and Ventersdorp. A similar formation is found forming the Kaap Rand west of Kimberley. I may state that many years ago I examined this district and found very large supplies of water issuing from the hillsides. The dolomite rock is found to contain large fissures and cavities which in the area just mentioned are filled with water, and which can be rendered available by shafts and boreholes. The formation also contains subterranean channels through which water flows. The direct flow of the water underground is considerably affected by the presence of granite dykes which causes the water to appear at the surface of the ground at certain spots like Wonderfontein and Klip River's Oog.

1496. What is the extent of the Company's works at Zuurbekom for the purpose of supplying Johannesburg with water?—The pumping station at Zuurbekom is on a site having an elevation above sea level of 5,194 feet. There are five shafts in existence—a trial shaft, a pilot shaft, a shaft in the main engine-house, a shaft known as No. 4, and a shaft known as No. 5 now in course of being sunk. At present water is only being taken from two shafts—that in the engine-house and in shaft No. 4. The yield from these two sources varies from 750,000 to 805,000 gallons per 24 hours, according to the rate of pumping. Shaft No. 5 was stopped at the beginning of the war, but at that time it was yielding between 600,000 and 700,000 gallons a day at a depth of 70 feet, without causing any reduction in the yield of Shaft No. 4, which is only 129 feet distant from it, measured from the centres of the shafts, and 113 feet measured from the sides. The water is raised from the shafts by pumps and delivered into a tank having a capacity of 50,000 gallons, thence it is pumped by the main pumping engines through 13¼ miles of 16-inch piping to an intermediate pumping station at Paarlshoop. The height of Paarlshoop above the ground at Zuurbekom is 445 feet. From Paarlshoop the water is pumped through about six miles of 14-inch piping to a high service reservoir, the difference of elevation between the two points being 340 feet, making 785 feet. The 16-inch pipe is capable of carrying 2,000,000 gallons per 24 hours. At present the engine power can only raise 1,000,000 gallons per 24 hours, but on the additional engines being set to work 2,000,000 gallons can be raised.

1497. These engines are now in course of erection?—Yes.

1498. In addition to the engines which can raise 2,000,000 gallons, provision is being made for a spare engine?—Yes; there is a spare engine and spare boiler power.

1499. And these 2,000,000 gallons a day will be available as soon as this extension is completed?—Yes, say in about six months time. It is dependent on labour and other conditions.

1500. Are you of opinion that this supply from Zuurbekom can be increased?—Certainly, I am of opinion that it can be very considerably increased. It is, however, impossible to state definitely the amounts which may be available, but judging from the information in my possession I think provision may be made for taking an additional quantity of 3,000,000 gallons per day, making 5,000,000 gallons in all.

1501. It is quite possible even for these figures to be increased?—Quite possible.

1502. What works are necessary for obtaining this supply?—In my opinion the works necessary will consist of shafts, boreholes and possibly headings, but it is quite impossible at this stage to say what the exact nature of the works will be.

1503. Can you increase the size of the rising main?—I recommend that when the additional rising main is put down it should be a 24 inch, which, although a little more costly in proportion to the 16 inch, will give a proportionate saving in the pumping expenses and it will enable the velocity in the pipe to be kept within the limit generally considered desirable.

1504. What do you consider will be the estimated cost of producing this additional quantity of water, say two, three, and five millions?—On the assumption that only 2,000,000 gallons per day are taken in the first instance, I estimate the cost of the works necessary for obtaining this quantity of water and for pumping and conveying it to the high service reservoir at £280,000, and adding the cost of the existing works and the extensions in course of execution, thereby enabling 5,000,000 gallons per day to be given, the total cost will be about £530,000.

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1505. And this supply will be more than adequate, judging from the past consumption at any rate, to provide the supply that is needed?—Yes.

1506. Now with regard to the Steenkopjes supply. What can you tell us about that?—The farm Steenkopjes is situated about 14¼ miles west of Krugersdorp on the road to Rustenburg. The source of supply is a spring which appears at a point in the dolomite where the ancient schistoze rocks, which form the boundary of the dolomite in this region, have been cut through by a kloof which offers a ready channel for the escape of the water. The elevation above the sea where the various springs run together is 4,915 feet, and the distance from the high service reservoir is 34½ miles. From a series of gaugings which I had taken in the dry season of 1896 the flow was found to be slightly over 15,000,000 gallons per day. I took an isolated gauging in May, 1899, which showed that there had been no falling off in the flow of the stream since 1896, and lately—on December 11th—I examined the stream and satisfied myself that there had been no apparent diminution. I could not take a gauging, however, as the gauge had been partially destroyed.

1507. Where does this water rise from?—The water rises from a spring at a point where the dolomite is bounded by the schistoze rock. In a general way, the manner in which the water appears corresponds to what happens when a piece is knocked out of the side of a saucer containing a liquid. The water is not brought to the surface by a dyke as in the case of Wonderfontein nor as in the case at Zuurbekom.

1508. What is the configuration there? What becomes of the water after leaving the spring?—After leaving the spring the water flows for 3,230 yards with a fall of 120 feet, thereafter it falls more gradually until it reaches Vaalbank, when it becomes comparatively flat, passing through a poort which I understand is called Doornbosch-poort, the river enters the Magalies Valley and turns sharply to the east, it joins the Crocodile River about 27 miles from Steenkopjes farm. I had gaugings taken of the river in December, 1896, where it passes through the poort into the Magalies Valley—which is about 4½ miles below the spring—and these showed that the volume was not greater there than at the spring. There is, however, a great extent of additional catchment area, composed of ancient rocks of an impervious character, between the spring and the poort, and there is evidence that the run-off in times of rain is very large. The water of the Steenkopjes River is not largely used for irrigation until it reaches Hekpoort, but it is used for driving two mills within three miles of the spring. At Hekpoort, all the water previous to the war used to be taken out for irrigation by means of six large channels. Beyond Hekpoort, the Magalies River receives the Doornspruit; thereafter there is more water in the river than is utilised for irrigation.

1509. What quantity of water do you consider could be taken from Steenkopjes without prejudicing the rights of riparian proprietors?—I consider that 10,000,000 gallons a day can be taken out at Steenkopjes spring without detriment to the riparian proprietors in the Steenkopjes Valley—that is, above the point where it joins the Magalies Valley—and that the proprietors below, that is, in the Magalies Valley itself, can be supplied from a compensation reservoir, to be formed by a dam which can be constructed in the poort already referred to. The poort, as a matter of fact, offers an excellent site for a large reservoir.

1510. Do these compensation reservoirs work satisfactorily for the other proprietors?—Oh yes. I think there are very few towns in England which get supplies from rivers which have not private compensation reservoirs, and they are very satisfactory, because they equalise the supply in the river, instead of the supply varying according to every rain—one day a flood and months afterwards a drought. The object of a compensation reservoir is to regulate the supply.

1511. What would be the size of your main from Steenkopjes to the high service reservoir, to convey the quantity of water you speak of?—In order to pump 10,000,000 gallons a day without having too much head allowed for friction, the size of the main should be 36 inches.

1512. That is larger than the figures that Mr. Goch gave us?—I understand so.

1513. Do you consider that anything under 36 inches would not be suitable?—I consider that when 10,000,000 gallons a day is passing through a pipe the size should not be less than 36 inches. I am well aware, however, that smaller sizes are used for temporary sorts of water supply, and where the supply is by gravitation.

1514. What do you estimate the cost would be for pumping and conveying this 10,000,000 gallons from Steenkopjes to the reservoir?—I estimate the cost of the works at £994,000, say, in round figures, £1,000,000.

1515. Is the quality of the water at Steenkopjes in all respects equal to that at Zuurbekom?—It comes from exactly the same formation, but, in my opinion, the merits of the source are not quite equal to those of Zuurbekom because there may be a possibility of surface water finding its way into the underground stream by swallow holes. The analysis shews that it is a very excellent water.

1516. It is far superior to any surface or drainage water?—Undoubtedly.

1517. Or say the Vaal River?—Without filtration the Vaal River water is out of the question. All the water from the dolomite formation is of excellent quality, but there are places where I think there is a liability to pollution by some flood waters being carried down.

1518. Finding its way through these small holes?—Yes, the different holes and dropping into what may be an underground river 100 or 200 feet below the surface.

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Mr. T. Stewart.

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1519. This does not apply to Zuurbekom?—No.

1520. These conditions are non-existent there?—No, they are not there. The water at Zuurbekom is got partly from infiltration into the shafts and partly from the boreholes which proceed to a considerable depth. I have handed in the analysis.

1521. And Steenkopjes?—I have not handed in an analysis of that.

1522. There are no mines or dwellings in the catchment area of Steenkopjes?—There are none on the dolomite within eight miles of the spring.

1523. And, therefore, there is no great danger from contamination?—No, there is no trouble there.

1524. Now with regard to Wonderfontein?—As regards Wonderfontein, I have not the slightest doubt that in the dry season the supply from Wonderfontein is of most excellent quality, as the analyses show that; but as Wonderfontein in a rather peculiar way is subject to increase from flood-water—it enters further up the Wonderfontein Valley—the point whether it pollutes the water or not should be settled before any water is taken from it by bacteriological examinations carried on throughout a whole year.

1525. What are the further advantages of these two schemes that you have given evidence on—that is Steenkopjes and Zuurbekom?—As the Zuurbekom source is only 18½ miles from Johannesburg, it, as well as the pipe line, can be more easily protected than any of the other sources.

1526. It is therefore advisable to utilise Zuurbekom as far possible owing to its proximity?—I have no doubt that until it is found that Zuurbekom cannot supply the quantity of water required, it is the best source to go to. It would be scarcely wise to go 30 or 40 miles when you can get an equally good supply—if not better—at 18 miles.

1527. After Zuurbekom, supposing that more water is required than the 5 millions, you can get it?—In that case Steenkopjes is quite as able to supply 10,000,000 gallons as any other source.

1528. With the advantage over Wonderfontein of being considerably nearer, and at a higher elevation?—Yes, about 10 miles nearer.

1529. With regard to the Vaal River, you have gaugings, I believe, showing that it is less than has been stated?—Yes.

1530. Do you consider that this scheme of the Vaal River is worthy of comparison with those with the dolomite formation?—Not without filtration, but I cannot imagine the Vaal River as a competitor for the supply of potable water against the dolomite, containing, as the latter does, practically an unlimited supply of already filtered water.

1531. The Vaal River water would be quite suitable for mines?—Yes, undoubtedly.

1532. In your opinion, do you see any reason why the mines should not have their own water scheme, and the water for domestic purposes be separate?—I see no reason whatever.

1533. And that there will be ample water for both?—Yes, plenty of water. There is abundance of water within fifty miles of Johannesburg for ten Johannesburgs.

1534. You will put in the gaugings?—Yes; the gaugings of the Klip River and the gauging of Steenkopjes Spring,* but the gaugings of the Vaal River are not put in, as they were not taken for the purposes of the Johannesburg Waterworks Company. I would prefer to give an abstract of them should they be required.

1535. You will not be disinclined to give all the information to the Commission that is required?—Not at all.

(*Mr. Thomson.*) I will leave that.

1536. (*Mr. Thomson.*) You have handed in drawings,† Mr. Stewart, showing the points referred to in your evidence?—Yes.

(*Mr. Thomson.*) The drawings have been handed in by Mr. Stewart to the Secretary, showing in detail the different points referred to, covered by the proposed water schemes for Johannesburg.

(*Mr. Thomson.*) Before closing Mr. Stewart's evidence, sir, I would like to mention that we only this morning had an opportunity of perusing Mr. Andrews' evidence, and Mr. Stewart would like to have an opportunity of putting in a statement and commenting on any of the answers given by Mr. Andrews, should he differ from him.

(*The Acting Chairman.*) When could that statement be put in? Could it be put in at the next sitting?

(*Mr. Stewart.*) Oh, yes—long before.

(*The Acting Chairman.*) Well, then, of course the cross-examination can be deferred till then if Mr. Stewart is coming up again. That would be more convenient to the Commission.

(*Mr. Stewart.*) I am not going away, as a matter of fact.

(*The Acting Chairman.*) I dare say that would be more suitable for Mr. Lance and the other gentlemen.

(*Mr. Lance.*) Yes, I think it would be better for Mr. Stewart's evidence to be complete before we cross-examine.

The Commission adjourned for Luncheon.

ON RESUMING,

(*The Acting Chairman.*) Mr. Thomson, will you proceed now?

(*Mr. Thomson.*) With regard to the suggestion I made, sir, that Mr. Stewart should have an opportunity of putting in a statement in reference to Mr. Andrews' documents, Mr. Stewart has had the opportunity of seeing the evidence, and he thinks that the figures which he has given in his evidence-in-chief will be sufficient, and he need not supplement that, so I do not propose to re-call him.

* See Appendix G. 2.

† Not printed.

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(*The Acting Chairman.*) They will want him for cross-examination later.

(*Mr. Thomson.*) When will that be?

(*The Acting Chairman.*) At the next sitting.

(*Mr. Thomson.*) This day week?

(*The Acting Chairman.*) We cannot fix the day at present, but probably soon. Probably this day week.

(*Mr. Thomson.*) I understand that Mr. Stewart's professional duties will require his presence in Capetown within a fortnight.

(*The Acting Chairman.*) The sitting will probably take place next Monday or Tuesday, and then he will be required.

(*Mr. Lance.*) Rather than run any risk of losing Mr. Stewart, I will proceed with the cross-examination at once. January 13, 1902.

(*The Acting Chairman.*) You see the other gentlemen concerned all agreed this morning that the cross-examination had better be postponed.

(*Mr. Lance.*) We may take it that we shall have Mr. Stewart?

(*The Acting Chairman.*) Yes.

(*Mr. Thomson.*) Then it will be taken next week.

(*The Acting Chairman.*) We will say about then.

MR. THOMAS RAYNES, called and examined:

1537. (*Mr. Thomson.*) You are the Resident Engineer of the Johannesburg Waterworks Company?—Yes.

1538. You have heard the evidence that has been given by Mr. Stewart, the Consulting Engineer?—Yes, I have.

1539. Do you agree with that evidence?—I do; yes.

1540. You have prepared a statement containing the rainfall from the different pumping stations*—pumping capacities?—Yes.

1541. You have also prepared a statement† of the supplies from Zuurbekom?—Yes.

1542. You have got the quantity of water pumped at Zuurbekom in the statement?—Yes.

(*Mr. Thomson.*) The statement§ containing the rainfall has already gone in.

1543. (*Mr. Thomson.*) With that quantity of water you have been able to supply the whole of Johannesburg?—Yes, slightly supplemented from other sources.

1544. No complaints of scarcity?—None whatever.

1545. And there was a surplus for the mines who requisitioned water?—Yes.

1546. You have also prepared a statement‖ showing the distribution over the town?—Yes.

1547. That statement includes the quantities supplied to the mines for mining purposes?—Yes.

1548. And there was supplied to the mines for mining purposes only from July to December 54,884,750 gallons, equivalent to 301,560 gallons a day?—Yes.

1549. From January to July 1899 you supplied 36,949,600 gallons?—Yes.

1550. And from July to December, 1899, 27,942,000 gallons?—Yes.

1551. That is respectively 301,565, 208,509, and 139,252 gallons per day?—Yes.

1552. And you were able to do this without there being any shortfall in the supply of the town?—Yes.

1553. Have you a statement shewing the number of leadings in the town?—Yes.

1554. And from the information at your disposal, you have come to the conclusion that the quantity per head does not exceed 30 gallons?—That is so. Mr. Thos. Raynes. January 13, 1902.

1555. The present consumption of Johannesburg is about the same as before the war?—Yes, it is.

1556. You account for that by the quantity consumed by the military and private supplies?—Yes, very largely.

1557. (*The Acting Chairman.*) Could you, Mr. Raynes, put in a statement showing the price charged for the water?—The Secretary will be able to put in a statement to that effect.

(*Mr. Lance.*) The evidence is almost entirely by statement and it is difficult to cross-examine.

(*The Acting Chairman.*) I take it, Mr. Lance, that you would like the cross-examination to stand over until you have had an opportunity of going through the papers.

(*Mr. Lance.*) Yes. I suggest that this method of giving evidence might be avoided in future, as a witness simply puts in a series of statements that we have had no opportunity of seeing. It seems to me that the Commission might let any written statement which is to be put in, be put in beforehand.

(*The Acting Chairman.*) They were handed in beforehand but not in sufficient time to allow copies to be distributed.

(*Mr. Thomson.*) They are merely statistics.

(*Mr. Lance.*) It seems to me that it makes so much delay.

(*Mr. Thomson.*) The same remark applies to every case. The other witnesses handed in statements and we were under the same disadvantages.

(*Mr. Dumat.*) I agree with Mr. Lance. Statements are handed in and the parties who appear in respect of other interests have not an opportunity of examining them because they have not seen them before and that means delay. If these statements had been submitted first, the cross-examination

* See Appendix G. 3.
† See Appendix G. 3.
§ See Appendix G. 1.
‖ See Appendix G. 3.

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of these witnesses might have gone on to-day. I do not see the objection which Mr. Thomson has in reference to these statistics and statements which are put in on behalf of their Company, being seen beforehand and examined.

(*The Acting Chairman.*) I do not think Mr. Thomson has raised any objection.

(*Mr. Thomson.*) I have raised no objection. I simply point out that the evidence led by Mr. Lance's client and Mr. Dumat's were under the same conditions. Statements were put in which were not submitted beforehand, and I think we had the same disadvantages in cross-examining as they have.

(*The Acting Chairman.*) You will all have copies as soon as they can be provided.

(*Mr. Lance.*) I may say that all our statements were in the hands of the Commission at least a fortnight before.

(*The Acting Chairman.*) As a matter of fact we only got the copies of the evidence which was to be given by the Waterworks Company yesterday, and then additional statistics have been put in, so it was impossible to deal with the whole matter. Copies will be furnished to all those concerned of the statistics handed in to-day.

(*Mr. Thomson.*) Of course that was unavoidable owing to the absence of Mr. Stewart, who had to go to Kimberly on business.

Mr. MONIER WILLIAMS, called and examined:

Mr. M. Williams. January 13, 1902.

1558. (*Mr. Thomson.*) What are you?—I am a Member of the Institution of Civil Engineers, and have been for many years chief Assistant to Mr. Thomas Stewart, who is a Member of the Council of the Institution of Civil Engineers, and he is also Hydraulic Engineer and Water Expert, and been connected with the working, designing, and carrying out of most of the large water schemes in South Africa. I was engaged on the design of these works in my capacity as the Chief Assistant to Mr. Stewart, M.I.C.E., Consulting Hydraulic Engineer in Capetown, and at present I am Resident Engineer on the extensions now in course of construction.

1559. You are in charge of the Zuurbekom works and the extension of the same?—Yes.

1560. You were present when Mr. Stewart gave his evidence?—Yes.

1561. With regard to the various water schemes of Johannesburg?—Yes.

1562. Do you agree with the evidence that Mr. Stewart gave with regard to Zuurbekom?—Yes; I agree with everything that he said.

(*Mr. Lance.*) I have no questions.

(*The Acting Chairman.*) Are there any more witnesses, Mr. Thomson?

(*Mr. Thomson.*) I call the Secretary of the Company with regard to details of meters.

(*The Acting Chairman.*) Is there any written document with reference to the evidence to be led?

(*Mr Thomson.*) No. It is merely technical evidence.

Mr. JAMES PAUL O'REILLY, called and examined:

Mr. J. P. O'Reilly. January 13, 1902.

1563. (*Mr. Thomson.*)—You are the Secretary of the Johannesburg Waterworks, Estate and Exploration Company?—Yes.

1564. And have been such for many years?—Yes.

1565. Since May, 1890?—Yes.

1566. You have a statement* showing the quantity of water sent to Johannesburg from Zuurbekom, from July, 1898?—Yes.

1567. Acquired from the books in the office?—Yes.

1568. This quantity is in addition to water supplied from other sources of the Company, such as Doornfontein and Weldevreden?—Yes.

1569. In addition to supplying Johannesburg and the suburbs with this water, quantities were supplied to the gold mines and the Netherlands Railway?—Yes.

1570. Can you tell us what this quantity was?—I think the quantity supplied to the mines has been handed in by Mr. Raynes.

1571. I ask you because the books of the office are in your custody?—Yes; they are. The quantity supplied from July, 1897, to June, 1898, over and above that supplied to Johannesburg was 4,195,300 gallons for the mines and 8,625,650 to the Netherlands Railway. From July, 1898, to June, 1899, it was 98,804,750 gallons to the mines for all purposes and 15,617,530 gallons to the Netherlands Railway.

1572. What were the number of leadings prior to the war?—The number of leadings prior to the war was 4,840.

1573. Were those all in supply?—No.

1574. How many were in supply, and how many not?—In supply, 4,292; not in supply, 548.

1575. And of those in supply, 4,152 were with meters, and 140 without meters?—Yes.

1576. And of those not in supply there were 410 leadings with meters, and 138 leadings without meters?—Yes.

1577. What is the number of leadings at the present time?—4,971.

* See Appendix G. 3.

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1578. How many of these are in supply? —3,010.

1579. And 1,961 not in supply?—Yes.

1580. And of these in supply, there are 3,008 with meters and 2 without?—Yes.

1581. And of those not in supply?—There are 1,825 with meters, and 136 leadings without meters.

1582. The number of services has increased?—Yes.

1583. The total number of services has increased?—Yes, but owing to the war a number are not in supply owing to the absence of the inhabitants.

1584. Can you give the names of the townships that are being supplied in addition to Johannesburg?—Yes, shall I name them?

1585. Yes?—Jeppe's Town, Troyville, City and Suburban, Fairview, Ferreira's Township, Belgravia, Wolhuter Township, Doornfontein, Bertram's, Marshall's Township, New Doornfontein, Fawcus Township, Fordsburg, North Doornfontein, Vrededorp, Burghersdorp, and Wanderer's View.

1586. And the only other water supply, the only private water supply in addition to tanks and wells, is that of the Braamfontein Company for Park Town?—Yes.

1587. I believe the Company has a charge for a minimum supply of a thousand gallons per month of 10s., and 2s. 6d. meter rent? —Yes.

1588. Are there cases in your experience where this minimum supply is not used?—Yes.

1589. Has the Company since its connection with the Zuurbekom scheme had any complaints as to shortness of water?—None.

1590. There has been sufficient to meet the demands of the population?—Yes.

1591. In addition to which you have supplied the mines?—Yes.

1592. The Waterworks Company has exploited its business without any assistance from outside—from the Government or elsewhere?—Yes.

1593. Or from the Town Council?—Yes.

1594. The shareholders have always provided what money was required for the extensions?—Yes.

(*Mr. Lance.*) You are supplying approximately the same now as before the war.

(*The Acting Chairman.*) Would it not be better to have copies of this evidence before you cross-examine?

(*Mr. Lance.*) If you think so.

(*The Acting Chairman.*) I should like to know if the Secretary is going to put in a schedule of the prices charged for water since the Waterworks started.

(*Mr. Thomson.*) I take it, it is open to the Commission to put any question they like to the Secretary.

(*The Acting Chairman.*) We prefer a schedule. If a schedule was put in of the prices charged, it would be very much easier.

(*Mr. Thomson.*) It would be rather a laborious task, I think.

(*The Acting Chairman.*) I think you had better try and get it for us. A schedule is wanted of the prices charged for water for every year to retail consumers since the Waterworks started.

(*Mr. Thomson.*) Yes; it can be done, but I cannot guarantee it will be completed for the next sitting. We will do it as expeditiously as possible.

(*The Acting Chairman.*) Can we have copies of Mr. O'Reilly's statement.

(*Mr. Thomson.*) The statement is more voluminous.

(*The Acting Chairman.*) I would like to ask, Mr. Thomson, if you do not propose to call one of the Directors of the Waterworks to give evidence in connection with the financial affairs of the Company.

(*Mr. Thomson.*) I think that is shown in the evidence before the Commission.

(*The Acting Chairman.*) I think the Water Commission would like to have the evidence and to have an opportunity of getting any information they require.

(*Mr. Thomson.*) I have not been instructed to that effect. I take it that the evidence we have had will give us the particulars. It gives us the particulars of the Company's capital, revenue from water, dividends paid, capacities of the Company's reservoirs and the whole particulars.

(*The Acting Chairman.*) It would be better for us to have it *viva voce* from the Directors.

(*Mr. Thomson.*) Would that not be more applicable to come forward if there was a Committee or Arbitration Court sitting, in reference to expropriation? There is no question of that at present. It would be more proper when such Arbitration Court was appointed. At present, I take it, the scope of the Commission is to inquire into the requirements of the town and the mines, and how those requirements can be supplied. I think it would be more appropriate when it comes to a question of expropriation.

(*The Acting Chairman.*) It is really for that reason that we want to obtain all the information possible, and I should recommend you to consider whether it is not advisable to have a Director to give evidence.

(*Mr. Thomson.*) We will consider that.

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(*The Acting Chairman.*) All information in connection with the financial affairs of the Company. If you decide to lead this evidence, we should like to know by the middle of the week, and what evidence you are prepared to lead.

(*Mr. Thomson.*) I do not see how that comes within the scope of this Commission.

(*The Acting Chairman.*) In connection with the water scheme as presented here.

(*Mr. Thomson.*) But this would be an enquiry into the past. I take it, what the Commission has to do is to enquire into the needs of the town, and see how they should be met.

(*The Acting Chairman.*) Would it not be a very great guide to know what has taken place in the past. I certainly suggest that it would be advisable for you to endeavour to get a Director to give evidence.

(*Mr. Thomson.*) I am sorry, Mr. Chairman. I am not instructed on that point.

(*The Acting Chairman.*) You will let us know by the middle of the week what you have definitely decided.

(*Mr. Thomson.*) If the Secretary could address a letter to the Company requesting additional evidence, then a reply can be sent.

(*The Acting Chairman.*) We do not request this; we only suggest it.

(*The Acting Chairman.*) The Commission will adjourn to a date to be notified later, and at the next sitting we will call Mr. Stewart for cross-examination, and hear whatever other evidence Mr. Thomson may wish to lead.

The Commission then adjourned.

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WITWATERSRAND WATER SUPPLY COMMISSION.

MINUTES OF EVIDENCE.

SIXTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

MONDAY, 20TH JANUARY, 1902.

Present:

G. V. FIDDES, Esq., C.B., Secretary to the Transvaal Administration (Chairman).

A. BRAKHAN, Esq.,
B. KITZINGER, Esq.,
W. St. JOHN CARR, Esq.,
J. W. QUINN, Esq.,
G. ROULIOT, Esq.,

G. CRAIG SELLAR, Esq., Secretary.

TRANSVAAL CHAMBER OF MINES (*Continued*).

Mr. H. H. Webb, called and further examined:

1595. (*Mr. Lance*, representing the Johannesburg Town Council.) In your statement you refer to 400 gallons of water per ton crushed per day, "make up water"?—Yes.

1596. By "make up water" you mean water that is lost?—Water that is practically lost, yes,

1597. So that in saying you require that amount of water you allow for using the water over and over again as far as you can?—Yes, over and over again.

1598. And you allow for taking all proper precaution against waste?—Yes.

1599. And in mentioning the total quantity of 20 millions per day you allow for using the water the mines already have?—Yes, we allow for using the water they already have, and there was taken into account also some water that was to have been delivered from new dams that were to be built.

1600. I think the water you already have works out at about 12 million gallons per day?—I can tell you if you wish to know.

1601. That is the statement of Mr. Poore?—I think it is about that. I have it here.

1602. I think that agrees with your figures, because by these figures, on the requirement of 400 gallons per ton crushed per day, for 17,000 stamps (which you assume in five years' time), this would work out at about 34,000,000 gallons per day all told?—Yes.

1603. So that in saying you want a quantity of 20 million gallons per day, you allow for using approximately 12 to 14, which you have at present, or may have from other sources. I just want to make that clear?—I have not totalled it up, but it is here on this list. I should say in the neighbourhood of twelve million gallons. It is not totalled up, but I think it is about that.

1604. In the 400 gallons you have allowed a certain quantity for domestic purposes?—Yes.

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1605. Can you tell us how much? What have you put down?—We allowed——

1606. I think you said about six gallons per inhabitant on each mine?—Yes.

1607. And in the number of inhabitants you included natives in compounds?—Yes.

1608. And they formed a very great majority of your inhabitants?—Yes, very large, when it comes to numbers.

1609. Now what have you allowed for in these six gallons?—We took that as an ordinary amount, an average from four different mines the names of which I gave you. I think there were five and it averaged six gallons on the different mines. The mines using ten gallons per head allowed for bath water and things of that kind—bath, drinking, and cooking water. For instance, the City and Suburban includes bath water for whites and blacks, and also drinking and cooking water. The Crown Reef includes bath water for whites, but only drinking and cooking water for natives, while the Bonanza includes bath water for whites only, and drinking and cooking water for natives.

1610. So I may take it, the requirements of the mines for what you call domestic purposes do not correspond at all with the requirements of the population of a town?—I should say not, because we made no allowance at all for sewerage.

1611. Nor for street watering?—No.

1612. Nor for gardens?—No.

1613. Nor for public baths or wash houses?—No.

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1614. Nor for cattle or washing carriages?—No.

1615. So that really what you refer to as domestic requirements do not refer at all to the requirements of a population of a town?—Simply the domestic requirements of the individual population of the mines, without reference to sewerage, public baths, or anything of that kind, although on the Simmer and Jack we have an old reservoir as a swimming bath for the benefit of the men.

1616. The natives on the mines live entirely in compounds, don't they?—Yes.

1617. And, therefore, for the most part might be called uncivilised, raw natives?—Yes, the majority are raw natives.

1618. I mean they are a good deal more raw than the natives living in the town?—That is so.

1619. In regard to these figures you mention, as having been given you by the different mines, have you had any opportunity of verifying them yourself?—Individually?

1620. Yes.—No, I have, in the case of our own mine—the Simmer and Jack—taken the records of that mine. In regard to the others I got the records from the head offices of these companies in town, and these had been handed in by their managers.

1621. With the exception of the Simmer and Jack, therefore, they are not within your own personal knowledge?—No, not my personal knowledge.

1622. Now you have given us some statistics on the consumption of water in certain English towns?—Yes.

1623. Why did you give us these?—Because on working out the average on the different mines mentioned, and arriving at this average consumption of six gallons per day per inhabitant on each mine, it seemed very low, lower than I thought it would have been, and so I looked up the matter in regard to the consumption of large cities. I quoted from this table to show that, for instance, a place like Nottingham with 240,000 inhabitants only consumed eighteen gallons per head, which included sewerage and everything. I put this in, together with other low estimates, just to back up my statement as to the consumption on the mines and to show that this estimate of six gallons per head was not too low for our requirements.

1624. You have already told us that the circumstances of the inhabitants on mines do not correspond with those in towns?—No, but if you consider all those other items eighteen gallons per head is a low consumption.

1625. Then you were on the look-out for towns showing the lowest consumption? You did not notice in the same book the American towns with so much larger consumptions?—I noticed these.

1626. I should like to go into these English statistics a little, and dispose of them. Your statistics are about ten years old, are they not?—1892-3, I think. I beg to state I quoted a complete list of English towns. I did not leave any out.

1627. I have your statement. It only gives 12, or rather, 16 towns.—I gave the complete list shown in that table.

1628. Yes, that is so. These statistics you did give are rather out of date. They are ten years old are they not?—Yes, but, if they could live on them then, they cannot be so far out.

1629. Do you know to what extent the supply in these different towns mentioned has increased since then?—No, I do not.

1630. Manchester and Birmingham are two towns you refer to as showing a low consumption. Do you know that both these towns are increasing their supply?—No, I do not.

1631. You don't know they have been short?—No, I do not.

1632. And do you know anything of Bradford, Edinburgh, and Nottingham; that all three have been short?—No, I do not.

1633. Bath and Chester, I believe, are both increased since these statistics were compiled. You don't know anything of them?—No.

1634. Now, are the English figures of consumption in towns any guide for a town here?—For a town here?—Yes.—Well, you had much better ask that question of a sanitary engineer or hydraulic engineer.

1635. Yes; but you brought in these statistics.—I did so to show the consumption of these towns was low, and in a measure they helped to justify our figure for the mines being low. I am not prepared to answer any questions here as to what would be the requirements of Johannesburg or any other town.

1636. It will be quite another story. Don't you think American statistics would be a better guide than the English?—I cannot answer that. They consume a great deal (such as Washington and Chicago), but draw their supplies from unlimited sources.

1637. You would rather say nothing on these points?—No.

1638. (*Mr. Thomson*, representing the Johannesburg Waterworks Company.) In your opinion, Mr. Webb, there is ample water in the vicinity of Johannesburg for all future requirements of the mines?—Yes, I think there is ample water available for the mines within a reasonable distance.

1639. You have made a study of the subject and give that opinion on information you have obtained?—Yes.

1640. You give it on the general information which has come to you as Consulting Engineer for the Consolidated Gold Fields?—Yes.

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1641. And you think each mining group would be quite competent to supply its own requirements as far as water is concerned?—I think that each mining group would be quite competent to supply its own requirements as regards money. They could finance anything necessary for water purposes.

1642. Exactly. You are aware a scheme is at present on foot for supplying some of the groups of mines?—I know that about the end of 1898 we thought that there was likely to be a scarcity of water and steps were taken by some of the groups to get a temporary supply to meet any shortage when it did come.

1643. What steps have been taken to turn that into a permanent supply?—I cannot give you absolute knowledge because I was not the engineer for the Syndicate. Mr. H. H. Webb. January 20, 1902.

1644. There is a supply of pipes on hand?—There is, I believe, but to what extent or how big a supply, I do not know.

1645. I presume you are prevented from giving (in your professional capacity) all the information you are in a position to give? I do not wish to ask you anything you know confidentially as Consulting Engineer to the Consolidated Gold Fields?—I think any information you want to obtain you can get from the Syndicate a great deal better than you can from me.

JOHANNESBURG WATERWORKS COMPANY *(Continued).*

Mr. THOMAS STEWART, called and further examined:

1646. (*Mr. Lance*, representing the Johannesburg Town Council.) I gather from your statement that your attention throughout your experience has been largely devoted to means of economising water?—Not at all. Mr. T. Stewart. January 20, 1902.

1647. But is it not so that you refer a good deal to prevention of waste and to steps taken by you in Glasgow to reduce the consumption?—Yes.

1648. Is not that the same thing as economising the consumption?—Yes. My experience was devoted to that subject for about two years, I believe.

1649. Therefore I may say your point of view is rather to make water go as far as possible, is it not?—Yes; not to waste water.

1650. Is it not to economise water?—My point of view is that more water than is absolutely necessary for the consumption of a town should not be consumed.

1651. Yes, no more than is absolutely necessary, and this point of view of economising water has been that of the Waterworks Company, has it not?—I do not know. They have been prepared to supply whatever was asked for.

1652. I see.—Since I became connected with them.

1653. Since you became connected with them they have supplied all that they have been asked for?—I understand there have been no complaints, but the Secretary and the Manager will be able to give you more definite information on that point than I can.

1654. I may take it that you consider waste to be objectionable in the use of water?—Undoubtedly, considering the value of water.

1655. You have told us some large American cities are spending large sums of money in order to have water to waste?—One large American city I quoted, Buffalo.

1656. And the American people generally are fairly shrewd, are they not?—They may be in some things; but as regards water for towns their own engineers say they waste two-thirds of it, and it will be found that the rate of typhoid in most of their towns, where the water supply is very high, is greater than in other towns where the supply is low.

1657. We had some medical evidence to the effect that there is not enough water until there is enough to waste. You don't agree with that, then?—No.

1658. Now you tell us that a sufficient supply of water for Johannesburg is about 20 gallons per head per day, I think?—I have said that 20 gallons is sufficient until you have a drainage scheme.

1659. Yes Can you give us any details of the 20 gallons? How would you work it out? You cannot say how much for domestic and other purposes?—No. I simply know that when you have a drainage scheme you want about 5 gallons per head additional for water closets and 5 gallons per head for other purposes and other things, bringing the total up to 30 gallons.

1660. And anything over 30 gallons you consider sheer waste?—Undoubtedly.

1661. And yet you suggest that we might have to include gardens, making 45 gallons in all?—Gardens are not included under domestic supply.

1662. We are talking of the consumption of the town?—I have not said that the total consumption should be 30 gallons. I have said that the consumption for domestic purposes should not exceed 30 gallons per head per day.

1663. You say, "I consider 20 to 25 gallons per head a very ample supply. I consider any surplus over 30 gallons per head sheer waste."—For domestic purposes, yes.

1664. Then we are to understand by that you meant domestic purposes only?—Undoubtedly.

1665. That is very important.—I defined what I meant by domestic consumption in starting off my evidence.

1666. (*The Chairman.*) Yes, that is clearly stated. That does not however include gardens?—No, Sir.

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1667. (*Mr. Lance.*) And it does not include street watering?—Yes, it does.

1668. Then we are not to understand from your evidence that you regard water for gardens as sheer waste?—Considered as part of the domestic supply it is sheer waste, but, if the inhabitants of a town want water for gardens and are prepared to pay for it, I do not suppose any company would object to supply it.

1669. Now you say that until we have a sewage scheme we should not have more than 20 to 25 gallons, but later we might have 40 gallons. Do you mean to say that the difference is put down to sewerage?—No, I say the difference between 20 and 30 gallons is for sewerage purposes. The water for gardens would not go into the sewers, nor would it be fouled.

1670. (*The Chairman.*) I did not catch your last words.—I say the water for gardens would not be fouled, sir.

1671. (*Mr. Lance.*) You mean surplus water for gardens would not foul nor would it be disposed of in the sewers?—No, evaporation would account for most of it while a proportion of it would sink into the ground.

1672. What I want to get at is, whether we should not have more than 20 to 25 gallons for domestic purposes, when we are to have 45 gallons later, and only 5 gallons of that for sewage?—I don't quite understand it. You mean for the 20 gallons per head available in Johannesburg now?

1673. You say we ought not to have more than that until we have a sewage scheme?—It is not necessary for the needs of the people, and if you did have more and spread it among your inhabitants, it would simply become foul water and lead to various ailments.

1674. I see. Then do you think the people at present have sufficient water?—As I have said before I have not heard of any complaints having been made since the Zuurbekom scheme was brought in. This, from my point of view, appears to show that a sufficient supply per head has been provided.

1675. You have seen the statistics by Mr. Raynes that were put in?—Yes.

1676. These, I think, show the Waterworks Company at present supply an average of thirty gallons per head?—Per leading, I think.

1677. Per head.—I think they have mixed up that, but even if the rate shewn is correct some of it is wasted.

1678. You think that there is wastage at present?—Undoubtedly, by the people supplied.

1679. Do you think people are likely to waste water at the price of 10s. per 1,000 gallons?——

(*The Chairman to Mr. Thomson.*) Are the gentlemen who were examined last week in attendance to-day?

(*Mr. Thomson.*) Mr. Raynes is in attendance. The only other one is Mr. O'Reilly, the Secretary.

(*The Chairman.*) Because I understand that it was clearly laid down by the Chairman that these gentlemen who were examined last Monday would be in attendance for cross-examination to-day. Will there be any difficulty in obtaining Mr. O'Reilly?

(*Mr. Thomson.*) It is rather awkward for him to attend to-day and in consequence he has signed a statement and that statement has been passed in, I believe, to the Board.

(*The Chairman.*) I do not understand how he could anticipate questions that might be put to him?

(*Mr. Thomson.*) The Chairman asked for certain information and this statement embodies the information, which he makes by resolution of the Board of the Company. If he is required we can send for him after Mr. Stewart's evidence is completed.

(*The Chairman to Mr. Lance.*) Was it your impression, Mr. Lance, that you would have an opportunity of examining Mr. O'Reilly?

(*Mr. Lance.*) That was my impression, sir. We were to have an opportunity of examining all the witnesses.

(*The Chairman.*) Then I think he should be sent for.

1680. (*Mr. Lance to Mr. Stewart.*) Do you think people are likely to waste water at the rate of 10/- per thousand gallons?—They probably would not waste it wilfully but in my opinion, having regard to the fact that some of the pipes (I mean the street pipes) have been in existence for a considerable time, and some of the branch services have been used for a considerable time, there is unnecessary waste going on. I may mention that just before the war, it was the intention of the Company to have made an investigation into the subject, and, now that we are resuming proper management, we are contemplating resuming the investigation as regards the discovery as to to the sources of waste.

1681. Yes. But now, does the wastage in the street pipes affect the consumption?—No.

1682. But it affects the total quantity of water supplied to the town and that is the basis on which these 30 gallons per head is taken?—It is the total amount of water supplied to the town, divided out into a certain number of taps, which, by the way, I understand, carry more families than one.

1683. Yes, but at what point is this water that is supplied measured? Is it not at the point it goes out? It is not the addition of all the various meters?—No, I understand that, but you will find out that better from Mr. Raynes, who has to deal with these details.

1684. You know that the consumptiou of water in Glasgow is somewhat high compared to English towns?—Yes.

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1685. And you have told us that is partially accounted for by there being a large number of baths?—Yes. I believe Glasgow has a bigger proportion of fittings to the inhabitants than any other town in existence.

1686. Don't you think the same thing applies here to a greater degree?—I have no reason to suppose so.

1687. You think not?—Water here would be about ten times the cost of Glasgow water.

1688. Yes, but is it not the case that the inhabitants here are, for the most part, a class that would require baths and more water generally?—There is no doubt whatever that a large section of the inhabitants here will require baths, but I think that in Fordsburg the proportion of baths will not be greater than the proportion which the workman class in Glasgow takes.

1689. Your Company has not supplied Fordsburg until lately?—I am merely referring to the type of population.

1690. I am asking a question of fact.—Mr. Raynes will be able to tell you.

1691. You cannot answer?—No.

1692. Do you know any reason why Johannesburg should take less water per head than say Plymouth or Middlesboro?—In the first place one of the reasons will doubtless be the consumption for trade purposes. I do not know what Middlesboro consumes for trade purposes, but I do know that Glasgow consumes 14 gallons per head for that purpose. Another point in connection with the supply of water to Johannesburg in future is that, when you start off here with the additional population, you start off with fittings tested and stamped according to the latest method of doing these things, while all the other towns have had to meet the contingency of old fittings which wasted water and yet could not be removed.

1693. You say we start off with new fittings?—For your extra supply.

1694. Oh I see, for our extra supply.—Yes. and in the case of a large proportion of the existing population the fittings, when a drainage scheme comes in, will be new. I am not aware there is now a large supply of fittings and pipes in use which would be unsuitable for a large scheme.

1695. I have not investigated them, but I do not see how you can transmit say 19,000,000 gallons of water through pipes hitherto carrying only 1,000,000. Do you know of any special trade purposes in Plymouth?—No, I do not apart from the shipping.

1696. Do you think the consumption of English towns is a fair basis to take for Johannesburg?—The consumption which I have quoted for several towns in England shows how much water is absolutely necessary and I am prepared to quote certain cases in India and elsewhere in hot climates. Since I gave my evidence the other day, I might refer to Jamaica where a report was made by Mr. Chadwick, who laid down very strongly that 30 gallons per head was ample for the purposes I have specified.

1697. Would you mind answering my question? Do you think English statistics of consumption a fair basis to take for this climate?—Yes, for the quantity of water actually required, that is with which a town can get along.

1698. And the towns you quoted in England you say are thus taking what is absolutely necessary?—Unquestionably. There is waste, of course, in many instances. The consumption given for all these towns is simply a case of the supply to each divided by the number of inhabitants. It is not got at by measuring the water for each house and adding them to get the total.

1699. Then in the case of Plymouth and Middlesboro, which take 60 gallons per day, do you think half of that waste?—The water required for trade purposes is included in that.

1700. You think so, but you did not know that was included in these two?—No, the consumption quoted for all the towns I gave is for trade purposes as well, and I do not know of a single case where the statistics published have not been for domestic purposes together with trade purposes.

1701. Are there no trade purposes in Johannesburg?—There are not very many at present, except the mines, which I have not included in my 30 gallons.

1702. There are other trade purposes, are there not?—Yes, but these I have included in my 30 gallons, such as soda water factories, &c.

1703. Breweries?—The brewery, I believe, gets its own supply.

1704. Then you include trade purposes as far as Johannesburg is concerned in your domestic supply?—I have already specified what is included in domestic consumption of water in the beginning of my evidence. That, as far as I was aware, included trade.

1705. But you say you have included it?—I gave you statistics as to what I considered was included in the term domestic supply. If the term is not understood——

1706. (*The Chairman.*) I think it might save time if this definition you gave were repeated. You are reported to have said, "The term, 'water for domestic consumption,' means, as I will show hereafter, water used for municipal purposes, such as street water, fire extinguishing, washing out quartz in places," is that right?—Closets. it ought to have been. Alleys.

(*The Chairman.*) I see. Then you go on, "public baths, washhouses, supply to public horse troughs, and urinals, and practically everything like that." Is that right?—That is the answer.

1707. Then that does not include trade purposes?—Strictly speaking, no.

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1708. (*Mr. Lance.*) Then any water for trade purposes in Johannesburg must be additional?—It must be additional.

1709. I see Sheffield is one town you have quoted as having a low consumption, Mr. Stewart, do you know that they have been short of water and are increasing their supply?—I know that almost all towns in the north of England were short of water during the last dry summer, possibly Sheffield included; but whether the reason for the increase of the supply is due to greater consumption of water per head or an increase of population, I do not know. I know Glasgow has doubled its water supply within the last 20 years, but the actual consumption per head within the last five years has decreased and I am prepared to give the figures.

1710. Yes. Can you give us approximately the latitude of the British Isles?—No.

1711. Am I correct in saying it is 50 to 59 north?—I don't have a geography book.

1712. And you don't know the latitude of Johannesburg?—No.

1713. Nor that of the United States?—No.

1714. Don't you think that the statistics of American towns would be very much more applicable than English towns as a guide to the needs of Johannesburg?—Certainly not.

1715. Why not?—Because in America the supply of water is obtained very easily. They have only to go to a river and they can get any quantity they want cheaply. Here there is no river. The distance that has to be gone to is great and the head to which water has to be pumped is greater than any other town I know of, of similar size. Again, as I pointed out, in America the result of their very abundant supplies is that the towns have a large percentage of typhoid cases while in a place like London the percentage is very small.

1716. Do you know what our percentage is here?—No, but then everybody has not got water and there is no drainage scheme.

1717. You said people were wasting water?—I did not say persons were wasting water. I said there was a waste of water. Investigation is proceeding as to the sources of this waste, but we have not discovered them yet.

1718. Your connection with the Waterworks dates from 1896?—Yes.

1719. And they were then supplying 600,000 gallons per day in the dry season?—So I understand, but that is a point on which the Resident Engineer can give you information.

1720. I merely refer to it because you do. According to Mr. Raynes they were then supplying twenty gallons per head to the people?—Per leading, I think.

1721. No, per head.—It may be so. As I said before, there has been a mistake here.

1722. I believe there was considerable shortage in the dry season at that time?—I believe there was, but the inhabitants of Johannesburg will be able to give you this evidence better than I can.

1723. You have referred in your statement to what you call some of the difficulties which the Johannesburg Waterworks Company have had to face?—Yes.

1724. And from these I gather that they did not extend their supply of water to a large extent because they did not know how the town was going to grow, in which direction and so on, and did not care to run any risks. I believe that was their point of view. The point of view, was a shareholders' one, was it not?—Well, I should think it would be.

1725. There was no obligation on them to supply water?—No, nor was there any obligation on any person to take it.

1726. Quite so. As prudent shareholders, looking at it from a shareholders' point of view they preferred to allow the population to overtake them rather than be ready for it?—I do not think so, because in the case of Zuurbekom they laid down a scheme for one million gallons per day, which has been sufficient up to this time, and two years ago they sent an order to England, which was executed and has been lying at East London for two years for the purpose of doubling the supply.

1727. We will come to Zuurbekom directly. That was in 1898. The Waterworks were formed in 1889 were they not?—I do not know.

1728. At all events, up to the Zuurbekom supply being brought in they had not attempted to anticipate the wants of the town?—Well, in 1896 they had some works in progress at Weltevreden, but naturally I know very little of what happened before 1896.

1729. Do you know the results from Weltevreden?—They got an increased water supply.

1730. To what extent, do you know?—I believe Mr. Raynes can give you that more definitely than I can.

1731. You refer to the inability to know in which direction the town would extend as a reason for possibly not meeting the requirements. Does that affect the question of supply here?—Not the question of the total supply to the town. It simply affects the question of supply to a particular area.

1732. Only a particular area?—Yes.

1733. The main supply for the town would naturally be brought to a high service reservoir and then distributed?—Undoubtedly.

1733*a*. And then it would be immaterial in which direction it went?—Yes, only if one section did not get water they would complain.

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1734. So that as regards the town generally the reason falls to the ground?—As regards the town generally, yes. The Company is not compelled to supply water.

1735. Now Zuurbekom was brought in in 1898?—Yes.

1736. Do I understand you to say the supply has been sufficient ever since Zuurbekom was brought in?—From the information submitted to me I understand no complaints have been received by the Company, but I would again refer you to the Manager who has been on the spot or to the Secretary.

1737. Do you know why large extra plant was ordered for Zuurbekom?—Yes to anticipate an increased demand for water owing to an increased population in time to come.

1738. Oh, I see. This was to anticipate an increase of population. I think you told us the supply from Zuurbekom might be increased up to five million gallons per day?—To the best of my belief that can be done safely. With the information at my disposal I believe it may be increased more, but I cannot say so definitely.

1739. And if this is done the total cost of the works will be £530,000?—Yes, including the works already in existence in connection with Zuurbekom.

1740. This includes intermediate pumping stations, pipe line, and service reservoir?—It does not include the service reservoir. It is the cost of the works necessary to deliver the water.

(*The Chairman.*) Mr. Lance, will you make this a bit clearer as I cannot understand Mr. Stewart's evidence on the point. It will save my putting a question if you bring out what the money is for.

1741. (*Mr. Lance.*) Will you tell us exactly what the £530,000 covers?—It covers the expense of sinking shafts at Zuurbekom and erecting pumping stations.

1742. Fresh shafts, Mr. Stewart?—Yes.

1742*a*. (*The Chairman.*) That is what I want to get at. Whatever work is, in your opinion, necessary for the development of five million gallons per day at Zuurbekom, and over and above that, every piece of plant to provide sufficient pumping power to raise that quantity of water to the high service reservoir. Does it mean new plant, or plant already on the spot?—Yes, and it includes the existing plant, sir.

1743. The plant now pumping one million gallons per day and the additional plant in course of erection?—The whole plant of the Company.

1744. The whole plant necessary for delivering five million gallons into the high reservoir. It does not include any increase in the high service reservoir. I understand it does not mean a bill of another £500,000?—That is so. I have given the additional cost separately.

1745. (*Mr. Lance.*) We may put it shortly thus: that, assuming you are supplying that quantity of water from Zuurbekom, £530,000 would be a fair price at which to take over the whole thing?—No, I don't say that. If it was taken over as old iron it might be so.

1746. That is what it would cost?—Yes, but it has got an earning capacity. I am not sitting here as an arbitrator on the question.

1747. No, but if it were taken over on the basis of cost?—If you were to pay what it has cost the Company in plant alone, it would not include the land nor the acquiring of the water rights of Zuurbekom of which I know nothing.

1748. No. The £530,000 mentioned only includes machinery, buildings and works?—Yes.

1749. (*The Chairman.*) Does it include the intermediate reservoir?—Yes, sir. It includes the increasing of its capacity so as to deal with the five million gallons per day.

1750. Merely the increase?—Yes, and it includes, of course, the cost of the plant there already.

1751. And the increase of the high service reservoir?—No, sir. Simply for delivering the water into the high service reservoir.

(*The Chairman.*) I see.

1752. (*Mr. Lance.*) Do you consider the water at Zuurbekom to come from a spring or not?—I have put down bore-holes, and I get water from them. This is all I know about it.

1753. Then you don't know if it is a spring? Mr. Willcocks expresses an opinion on the subject, but you don't?—No. I have been on the work for five years.

1754. Now, as to the water you get at Zuurbekom, is it water actually in the dolomite or in the ground before you reach the dolomite?—There is a small proportion that comes in before we get to the dolmite, but by far the bigger proportion comes from the dolomite.

1755. How much will the extra power you are about to supply pump?—Another million gallons into a pipe which is large enough to take the additional million.

1756. Yes, and then supposing you are supplying two million gallons, will you have any reserve power?—We shall have one-third reserve power in engines and pumps. Supposing the machinery was divided up into three pumping engines, one pumping engine might remain at rest, and the other two will do the work.

1757. That will be the case when you are supplying two millions?—Yes, each of the pumping engines is sufficient to pump one million gallons through a 16 in. pipe.

1758. Do you know the indicated horse-power of the engine there now?—No, I don't remember that. The specification will give all that.

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1759. You propose to lay new mains between Paarlshoop and Johannesburg for a larger supply?—Yes, a 16 in. pipe is the intention.

1760. Then as to your increased plant at Paarlshoop, you have some margin of reserve there?—Undoubtedly.

1761. Mr. Bennett gave us an estimate of the cost of pumping 1,000 gallons to a height of 350 feet, and said that with coal costing £3 5s. per ton, it worked out at a fraction under 3d. Is this about what you considered the cost here?—I have not worked it out.

(*The Chairman.*) £3 5s. per ton for coal seems a very high price.

(*Mr. Lance.*) That was for Welsh coal, sir.

1762. (*Mr. Lance.*) Do you think it anywhere near the mark for Johannesburg?—As far as that goes I am not prepared to give the information without the consent of the Company. The cost of the water to the Company seeing they are prepared to sell at a certain price is a matter for them.

1763. It is not a question of selling but of cost?—I am sorry I do not see my way to give the information.

1764. You cannot answer without the consent of the Company?—No.

1765. Then I suppose the Company has really practically edited your evidence?—No, they are aware of it.

1766. It was submitted to them?—Yes.

1767. Is not that so?—It is so.

1768. And they approved of such evidence as you have given?—Certainly.

1769. (*Mr. St. John Carr.*) I should like to ask about Question 1463 of your evidence. You say that where water is cheap the rate of consumption is high. Now do you mean to say, or rather to convey, that where the cost of water is high the consumption of water will be low?—That is so. It is generally the case that people do not take so much water when it is at a high price.

1770. You estimate and show the average consumption which has taken place in Johannesburg, where the cost is high, and state this as a reason for a large consumption in other towns, therefore I say it is a conclusion that the small consumption in Johannesburg is due to the fact that the cost has been very high.—No.

1771. Well, it would be conveyed by it?—Yes.

1772. Then, in answer to Question 1479, you seem to insinuate, when referring to the estimates of the increase of population, that the Water Commission could not be in such a good position to estimate the increase of population as the Waterworks Company. I should like to know on what you base that idea?—My intention in putting that in was to show that a Waterworks Company, knowing its consumers, is generally in a better position to know what the increase is likely to be than another not connected with the Waterworks. It has nothing to do with the actual Commission but a question of fact which happened with the Royal Commission on the London Water Supply.

1773. I thought there was something behind this, because I don't think that is a sufficient reason. It is not very clear to me. Then there is another point where, in one paragraph, you state that the inhabitants of Johannesburg are not bound to take water from the Company, and it is a fact also that the Company is not obliged to supply water to the inhabitants. Is that not the case?—I believe so, sir. In most municipalities the inhabitants are bound to take the water if the main pipe is laid within a certain distance of their door, and whether they use it or not they are bound to pay for it.

1774. There is another question I wish to ask you. Has the Waterworks Company taken any steps whatever to go on with the Steenkopjes scheme?—They made a survey in 1896 but the Zuurbekom scheme having been brought forward towards the end of the surveying operations and, as the amount of capital involved in Zuurbekom would be less, while the resources of the latter appeared to be sufficient for the wants of Johannesburg for some time to come, the Steenkopjes scheme was then abandoned. The investigation which was made included the making of surveys and the taking of gaugings.

1775. But no work has been done?—No.

1776. I do not know whether it has come within the notice of your large experience as to the cost of water in the various places with which you have been connected. Don't you think the price here is very high compared with any other place you know of?—Undoubtedly the existing price is high, but then the conditions are somewhat uncertain. I take it that if the Company had the privileges or the power, such as certain Municipalities possess—the privilege at Glasgow, to take an example, as to compelling a man to pay for water if the main is near to his door—probably enables them to charge less. That is a point they must answer for themselves.

1777. Then there is one observation of yours which struck me. I don't think you could have meant it in the way it was put. You were asked as to whether you knew Zuurbekom was a spring or not. You said, "No, all I know is I put down a shaft and up comes the water."—We put down a bore-hole. A spring as a rule is the name applied to water which appears on the surface.

1778. With regard to your idea as to the permanency of the supply, I take it before recommending your Company to go to this large expenditure you were able to satisfy them to some extent as to the permanency of the supply?—Undoubtedly.

1779. Can you give the Commission any idea as to the grounds you based that on?—We had made a very thorough geological survey of the catchment area and we saw

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that the pumping of one million gallons from the works there, or rather the pumping of half-a-million gallons from one shaft did not affect the water within 113 feet of it, consequently we were making no impression on the water in the surrounding ground.

1780. You stated that the total cost of the plant required to deal with five million gallons daily would be £530,000?—Yes.

1781. That is to say, does that £530,000 include the original cost of the existing plant, or is it the original cost, less depreciation?—It is the original cost of the existing plant; money spent on works by the Company.

1782. (*Mr. Brakhan.*) Can you tell me whether, since the Zuurbekom has been working with the present machinery, any water has been supplied for domestic purposes to the town from any other source?—That I don't know. It is entirely a matter for the Resident Engineer and Manager.

1783. I believe the bore-holes have given a little at times. In Mr. Rayoes's statement it will be noticed he makes a remark to that effect?—It was only at certain times they were worked. I do not know what the water was used for.

1784. You stated that a certain amount of water came into the shafts prior to the dolomite formation being reached at Zuurbekom?—Yes, we reached water at a certain distance down which came in from the superficial accumulation.

1785. Has any analysis ever been made of such water?—Yes, I have handed it in, sir, and I have a copy of it which I will read if you wish me to.

1786. I speak only of water caught before the dolomite formation is entered?—I have a separate analysis of that, sir.

1787. Is it satisfactory?—Quite satisfactory. The analysis shows that the water is rather an improvement on rain water. It is rain water which has been filtered.

1788. In other words, there is no contamination whatever?—Absolutely none.

1789. As regards the outline you gave of the Steenkopjes scheme, I take it the reservoir you recommend, the compensation reservoir, is merely to retain water which will be caught there in the rainy season so as to supply the demands of the owners further down?—Yes, those who, of course, might be affected by the taking out of the water higher up.

1790. Yes. In other words, I understand that the water which is to be pumped from Steenkopjes is to be pumped up to your reservoirs direct from the spring?—That is so.

1791. And will be in no ways contaminated?—That is so.

1792. While the surplus water, I take it, will flow into the compensation reservoir which will simply be filled in the rainy season by the rainfall?—That is so.

1793. Can you give us roughly an idea of how much water that reservoir is supposed to hold?—I have not taken out the details of it, but it could be made practically any height that might be desired. It may come to be a question whether some contribution should not be made to it, with a view to making it larger than what would be reqired to make up for what the Waterworks Company takes, because it is very well situated for an irrigation reservoir, but I have not gone into the details.

1794. Now on a rough forecast there will be a very large reservoir, which will also drain a large catchment area of rainfall?—Yes, a large area in addition to the area which drains through the range of mountains at the spring. It is an additional drainage area to what supplies the spring itself.

1795. And the configuration of the country there lends itself particularly well for building such a reservoir?—A very excellent site for a reservoir in my opinion, and, although I did not give it in the course of my evidence, I do not think it is impracticable to build a dam as well across the poort where the spring comes out, and bank up a great quantity of additional water in the dolomite itself. It is quite possible.

1796. (*Mr. Quinn.*) You said in your evidence that you first visited Johannesburg in 1893 to discuss the Waterworks business?—Yes.

1797. At that time did you give any report on their general supply?—No, not on the general supply, as far as I remember. To the best of my recollection no, but I am not sure about it. I have no recollection of it whatever.

1798. Have you any recollection of the supply in those days?—Yes, I certainly did not think it a very good supply.

1799. Will you tell us what it was then?—Well, to the best of my recollection they had just finished the reservoir known as No. 3.

1800. In 1893?—Yes. No. 3 was just finished. It filled either that season or the next.

1801. I don't want to know about the reservoir. I want you to tell us what you know about the sources of supply in those days?—The sources of supply were entirely local, one being behind the Manager's house on the top of the Doornfontein Valley. I think they also had a supply from Bezuidenhout's Spring but I have really not gone into that for the purpose of this Commission and I have forgotten all about it. I looked to the future in getting up my evidence.

1802. We are interested in the past a little. Were you aware that the Engineer, then employed by the Waterworks Company, wrote a report in which he warned them in very strong language against the quality of the water they were using at that time?—I do not know anything of it.

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Mr. T. Stewart. January 20, 1902.

1803. The Bezuidenhout Valley was purely surface water was it not?—It was a spring, I understand. There was some surface water which went down the valley but what happened to it I cannot say.

1804. I thought possibly that seeing you came specially to consult with them they would naturally put before you such counsel as they had had from the Engineer on the spot, and he in 1893 pointed out the danger of this supply. I thought that perhaps you might have observed it yourself and would be able to tell the Commission something about it.—The reason for my coming here in 1893 was to make a report on the construction of a certain reservoir, and thereafter I designed a scheme for bringing water from the Vaal River.

1805. (*The Chairman.*) For this Company?—Yes, for this Company. The Engineer on the spot was not at all under my control, and the Company did not ask me to report on the waterworks as far as I remember.

1806. (*Mr. Quinn.*) Will you tell me your opinion as to the Weltevreden supply. Just before you came here, I understand in 1896, the Waterworks Company spent a large sum of money in getting that supply and one or two others. Have you examined it at all? Do you know anything as to its value as a source of supply?—I have examined it but do not know its value, as with Zuurbekom in existence there is not so much need for it, but it is a valuable source of supply for some purposes.

1807. You have given us, Mr. Stewart, your opinion as to the possible resources of Zuurbekom as a source of supply. Zuurbekom, I understand, was acquired after Weltevreden, and I should have thought you would have had some special knowledge as to the possibility of the supply at the latter. Can you give us some definite information as to whether there is any real supply and to what extent?—The quantity of water available in the springs is contained in the return sent in by Mr. Raynes. To my knowledge there are roughly about 300,000 gallons per day without storage. As I pointed out one of the reasons for abandoning it was the discovery of the Zuurbekom source. At the time I knew nothing as to what the rainfall was on that area and less as to how much of it came off to be stored.

1808. Yes. Seeing that soon after the acquisition of Weltevreden you looked out for another supply it seems safe to assume you found Weltevreden a complete failure for the purposes intended?—I found Zuurbekom was giving a better supply.

1809. But I am talking as to the quantity obtainable, and you found Weltevreden was not going to do?—I found Weltevreden could not meet a large increase in the consumption in years to come. For example there was no possibility of getting two million gallons per day from Weltevreden, while there was the possibility of this being got from Zuurbekom. If Weltevreden had been constructed we should have had to go to another source ultimately.

1810. That is what I want to get at, the value of Weltevreden in your opinion as a source of supply. In answer to a question put a little while ago you said, giving no reason of course, that the present price of water was very high.—So it is, undoubtedly.

1811. Then it would be very much higher when it was at one time four times as much, I think 40/-.—Certainly 20/- to my certain knowledge.

1811*a*. That I suppose would be an unheard of price in any large town?—I should think it rather an excessive price.

1812. I am perfectly positive about the 20/-. I suppose the Secretary will give these statistics but if 10/- is high what is a charge of 40/-?—It all depends on the conditions. If you have to go five miles for a bucket of water you may have to pay a shilling for it.

1813. In answer to another question you told us it was not compulsory on people to take water, while, as a matter of fact, they really had to take the water or do without.—Yes, but it was not compulsory on them to take water from the Company. They might have sent 20 miles for water and therefore the Company could not look for any revenue if a ratepayer wanted to help himself elsewhere.

1814. That did not apply to Doornfontein, where they had to pay for the water whether they used it or not?—Yes, but I am speaking in a general way.

1815. You spoke of the catchment area of Zuurbekom. What is the extent of it?—The extent of it as regards the dolomite is about 24 square miles but the dolomite is not the only catchment area because the slopes of the Gatsrand bring in water which, it is presumed, goes into the dolomite ultimately. Of course our surveys are not so very exact; but I take it we get a proportion of the rainfall flowing from an area exceeding 60 square miles.

1816. What extent of ground do the titles of the Company cover at Zuurbekom?—I think, 10 morgen, to the best of my recollection.

1817. Is it not quite likely that if other people were to put down bore-holes water would come up? In other places, such as Cypherfontein, for instance, you are aware that in sinking a shaft for coal they struck an immense body of water, and, if bore-holes were put down near Zuurbekom, is there not a possibility of water coming up just as at your works?—There may be the possibility, but as a matter of fact, in two shafts at Zuurbekom we practically drew blanks, and got no water.

1817*a*. You really cannot say you are sure of getting water. If you wish to increase the amount of five million gallons per day at Zuurbekom, and sink bore-holes, you may draw blanks again?—Some, doubtless; but I am convinced we will get a supply ultimately by the means stated, viz., bore-holes and shafts.

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1818. (*The Chairman.*) There is one question arising out of your evidence. It is quite news to me that you drew blanks in sinking shafts at Zuurbekom. That does not seem to square with the theory of an underground sponge which has been developed here. What is your explanation, geologically, of drawing a blank?—Oh, we did not hit off a fissure. In order to get the large quantity of water we have got we must have struck into a kind of fissure. When I say that we drew blanks, it was a question of about a quarter of a million gallons out of the two shafts, from surface percolating water. We got no additional water after going beyond 120 feet in depth. We got water from a superficial deposit, and then, not getting more water as we proceeded lower down, we sought for water further afield, sinking shafts a bit further off. When we got to the bottom and put down bore-holes, we reached a fissure. I am not a believer in the talk about very large quantities of water said to exist in the dolomite, and that it is honeycombed with tremendous reservoirs and underground rivers.

1819. You are not a believer in them?—Certainly not.

1820. Then your idea, I take it, of the water supply at Zuurbekom is that it is of the nature of a basin or fissure?—Yes, sir.

1821. It is not an underground flowing river?—No, sir. As far as our evidence goes I should be sorry to say it is an underground flowing river.

1822. You have seen no evidence of current or anything of that kind?—None whatever.

1823. I understand you to say that when you had the shafts and then your bore-holes, you think it a piece of luck that you struck a fissure?—Undoubtedly.

1824. Because I had an idea that it was rather a nuisance than otherwise to strike a fissure as it meant brickwork to support your shafts?—The fissure or whatever we got into is some considerable distance below the bottom of our shaft.

1825. But it is a fact that in sinking these shafts one of your annoyances with dolomite is that you may have to get through a cavern that would be a difficult thing to pass from an engineering point of view?—Oh, that would not be insuperable. There are, of course, portions of dolomite on each side of the fissure which make it perfectly secure. There are underground rivers, one at Wonderfontein, and I consider the Steenkopjes spring is an outlet corresponding to an underground river. There may be two or three for all I know.

1826. That is to say a fissure expanded to such dimensions as practically to constitute a river?—Yes. At Wonderfontein you can walk about in the water of the river underground.

1827. To increase your supply to five million gallons from these ten morgen at Zuurbekom, what would be your idea of the total number of shafts you would require to put down?—I could not say how many shafts, but I may mention that our ten morgen of ground is not confined to one piece of ground. We may, if I am not mistaken, take the ten morgen at various points over the farm of Zuurbekom.

1828. On prospecting options, as it were?—We can take it in pieces over the farm.

1828*a*. I see.—I am speaking from memory.

1829. That I understand. With regard to the water, you don't think there is any possibility that whereas it could go on indefinitely supplying one million gallons, you would gradually be drawing on the resources of the basin if you were taking five million gallons and there would be an increasing shrinkage?—Well, we might. That is why I prefer to say we do not expect more than five million gallons. We should be able to see that as we went on developing the resources. It is almost impossible to say definitely, but, as far as our preceding operations have gone, they prove without any question that the taking of 1½ million gallons per day does not lower the water level in the adjoining shafts.

1830. So much I understand, but it does not necessarily follow from that, that if you take off double the quantity it would not affect the level?—Not necessarily.

1831. No engineer would pledge his reputation that it would not?—No, it would lower the water level, only we must have further evidence. If we did lower the level, we might simply be drawing water from an increased area. Experience in England in underground sources shows that you may lower your water level and still get your supply.

1832. You don't regard your supply as a closed basin into which only a certain amount of water makes its way and it must be drawn upon beyond the limit of recuperation if you are to increase your supply?—I don't follow you.

1833. I mean to say it is possible, is it not, that the area which feeds your shafts is a self-contained area, and that rain water, which after all is your ultimate supply, falling outside of that area, would not increase the amount you would get in your shafts. I mean to say that you have not the whole area of the dolomite to draw upon?—Undoubtedly so.

1834. There are limits beyond which the rainfall does not affect you?—Yes. This is clearly seen between Wonderfontein and Steenkopjes, the water flowing north at one part and south at another.

1835. Then within the area, whatever it is, which supplies your water, there is a certain rainfall, and a certain amount that is soaked up by the dolomite for use?—That is so.

1836. If you once begin to draw more than that amount, whatever it is, you would, after a time, be drawing on the reserve

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Mr. T. Stewart. January 20, 1902.

store in the lower depths of the dolomite, until eventually you squeeze the thing dry. Is not that so? I ask merely as a matter of theory?—If your pumping power was excessive, too great for the quantity of water brought in by the rainfall for use, you might exhaust the supply, but in actual practice, you stop extending your works when you see that you have lowered the water level, or perhaps you watch that you do not lower the water level too much, so that the rainfall of the succeeding wet season would not, as it were, recuperate the space you had made.

1837. Quite so, I see that. You stop pumping, but at the same time, you stop the supplies of the people depending upon it. You limit the extent to which you would pump. You would not proceed with new works. I mean, you would have indications before you put down additional works which might prove abortive?—In all underground water supplies you must proceed tentatively.

1838. I understand.—As I indicated, I do not make any very large estimate for the additional amount of water. When you have got five million gallons and pumped for a year, and seen what the effect on the area is, we might be prepared to say, you may increase your supply.

1839. But you might be compelled to go further afield for another supply?—That is so.

1840. So that there is the element of risk in any scheme?—Yes, in any scheme dealing with underground sources.

1841. In any scheme connected with the dolomite or water from underground?—That is so.

1842. As far as you have seen, you say you have noticed no indications of the Zuurbekom not being able to supply five millions indefinitely?—That is so.

1843. (*Mr. Thomson.*) Before Mr. Stewart leaves the table, I should like to state that a good many statistics have been given as to the annual consumption per head. Mr. Stewart has, I believe, a report of the Town Council of Johannesburg for the year 1895, in which valuable evidence was given on the point. Would you like me to tell you what is stated there?

(*The Chairman.*) I do not quite understand. Is Mr. Stewart the only repository of the report of the Town Council?

(*Mr. Thomson.*) It may not come under the notice of the Commission.

(*The Chairman.*) It is something from your point of view?

(*Mr. Thomson.*) It is merely evidence which has been given.

1844. (*The Chairman.*) Proceed, Mr. Stewart.—In a report of the Public Works Department Sanitary Board of 1896, under the heading of "Sewage Volume," it is stated by a Commission appointed to go into certain plans for sewage disposal, that "in order that we might have some definite data from which to calculate the dimensions of the outfall sewer, we have had to carefully consider what would be the average number of gallons of such discharge per day *per capita*. We have arrived at an estimated average of 30 gallons *per capita per diem*. This estimate, we may say, has been arrived at from a calculation made of the present average daily consumption of water *per capita*, and, from personal experience of such discharges from such works in European towns, the average of 30 gallons is for sewage proper. We strongly advise the exclusion of rainfall from sewers. This should be made a stringent regulation in the drainage of all properties. For the same reason no satisfactory arrangement could be devised which would allow of even partial admittance of rain water, and for obvious reasons with regard to initial cost of works, climatic conditions, and other sanitary objections, the total exclusion of surface rain water must be rigidly enforced."

1845. Whom is that signed by?—By Mr. G. R. Andrews, C.E., late Town Surveyor, Bournemouth, and Borough Engineer of Brighton, Mr. J. Fletcher, A.M.I C.E., Borough Engineer, Durban, Natal, and H. C. Werner, C.E., Consulting Engineer, Johannesburg.

The Commission adjourned for Luncheon.

ON RESUMING,

(*The Chairman.*) Is Mr. Raynes here?

(*Mr. Thomson.*) Mr. Raynes will be here in a minute. He had to go to Doornfontein. Mr. O'Reilly is here.

(*The Chairman.*) Then we will take Mr. O'Reilly.

(*Mr. Lance.*) I see Mr. Raynes has just come in, sir, and I would rather take him first.

Mr. THOMAS RAYNES, called and further examined:

Mr. Thos. Raynes. January 20, 1902.

1846. (*Mr. Lance.*) I think you said you agreed with the evidence of Mr. Stewart?—Yes.

1847. And do you share his views as regards economising water?—Undoubtedly.

1848. And you consider his estimate of the requirements is sufficient?—Ample.

1849. That is 20 to 25 gallons?—Yes, for domestic purposes.

1850. And do you give the same definition of domestic purposes as he does?—Entirely.

1851. These statistics* of yours have been very carefully compiled, have they not?—I think so.

1852. They deal, don't they, with averages?—Yes.

* See Appendix G. 3.

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1853. You don't give your maximum and minimum?—No, but it could be supplied.

1854. Why do you give us the half-years always from 1st January to 30th June and 1st July to 31st December?—Because the 30th June is the end of our financial year.

1855. But that does not affect statistics of this sort?—Not in the least.

1856. What I want to get at is this. By giving statistics in this form you get the wet season partially in the one half and partially in the other?—Yes.

1857. Why do you not give us the statistics from 1st April to 30th September and then from 1st October to 31st March?—Because we keep our statistics in that form and it is more convenient for some purposes.

1858. It is more convenient, but if you did give them on the dates I suggest you would have had a maximum and a minimum, would you not?—Undoubtedly.

1859. There is just one week where you have given us a maximum. That was in October, 1898?—Yes.

1860. You told us then you pumped 13 million gallons in one week, from 22nd October to 29th October, 1898?—Yes.

1861. So that you then supplied nearly two million gallons per day?—Yes.

1862. And that on your statement showing the population you supplied at 30,000 meant 66 gallons per head for the week?—Yes, but fully half we supplied to the mines.

1863. Oh, is that so?—Yes, for mining purposes only.

1864. Do you show that?—I do not. I state the amount supplied during a certain half-year.

1865. Your statement is that that is what was distributed to the town. Do you wish to correct that?—I simply say the highest week's consumption. I include the whole district in the town.

1866. You include the mines in the town?—Certainly. They are supplied through the town mains.

1867. Then you can tell us how much in that one week you supplied to the mines?—No, I do not have it before me at present. I can get it if you like.

1868. At that time, Mr. Raynes, in October, 1898, is it not a fact that you were short of water?—Oh, no, we were not.

1869. Were you not calling on householders to be economical in 1898?—We were not.

1870. Were you not telling them not to use water on gardens?—Certainly not.

1871. Is there not a big difference between the minimum and the maximum?—Yes, very large.

1872. Your average supply under normal conditions before the war was approximately one million gallons per day?—Not quite. It was nearly a million.

1873. I thought your statement showed this?—On two occasions it rose to one million.

1874. Can we say a million a day has been the maximum?—You can say one-and-a-quarter millions has been the maximum.

1875. That would give for 30,000 people 40 gallons per head, would it not?—Always excepting the mines.

1876. Yes. The quantity you supply to the mines is not very considerable?—At that period it was very large.

1877. Cannot you give us what your maximum has been to town without the mines?—I think I can. At that particular time the maximum supply to the town was 802,000 per day.

1878. What time are you speaking of?—At the time when we supplied 1¼ millions.

1879. When was that?—During the half year from July to December, 1899.

1880. Then you mean to say that the maximum you have ever supplied to the town, apart from the mines, is 800,000 odd?—Thereabouts.

1881. Well then with the mines you have been supplying something about 30 gallons per head?—Yes.

1882. And that is in excess of what you consider necessary?—Decidedly.

1883. You think waste is going on at present?—I am quite sure of it.

1884. Besides the water you are supplying there is a very large quantity of water in this town obtained from other sources, from wells and tanks, is there not?—I should not say a very large quantity—a certain amount.

1885. You told us you are only supplying 30,000 people. Where do the rest of the people get their water from?—It is not within my knowledge.

1886. No, but is it not as a matter of fact within your knowledge that there are a great many tanks and wells?—Certainly.

1887. So that your supply does not anything like represent the total supply to the town?—No, but I should say it represents a very large majority.

1888. Do you think 30,000 people are the majority of the inhabitants?—Yes, I do.

1889. Taking white and black?—No, not the black. The blacks employed in households only are included.

1890. Well, then, what do you put the population of the town at under normal conditions?—I don't attempt an estimate.

1891. You do in as far as you say that you think you are supplying the majority?—Well then I stick to the broad statement.

1892. In 1896 your connection with the Company commenced, did it not?—Yes.

1893. You were then short of water, were you not?—Yes.

1894. Did you, when you came, have access to any prior reports of the Resident Engineer?—No, I had nothing whatever to go upon.

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Mr. Thos. Raynes

January 20, 1902.

1895. You did not see a report from the Engineer in 1893?—No.

1896. When you came in 1896, there was considerable shortage. Did you take any steps to meet that?—Steps were already being taken when I came.

1896. That was in connection with Weltevreden?—Yes, and Zuurbekom.

1898. The Weltevreden was prior to Zuurbekom?—That is so.

1899. What supply did you succeed in getting from Weltevreden?—The supply varied from a quarter of a million to half a million gallons.

1900. Can you give us any idea of what the expenditure was on Weltevreden?—No, I know nothing about that.

1901. Weltevreden did not materially help you?—It kept us alive.

1902. From 1896 up to the time that Zuurbekom was brought in, there was considerable shortage, was there not?—At times, yes.

1903. Was it not the case that in every dry season you were very short?—Well, every dry season only represented 1897-1898 in my experience.

1904. Were you not short then?—We were short in 1897.

1905. And you still say you were not short in the dry season of 1898?—We were not short.

1906. What led to the ordering of the extra plant for Zuurbekom?—Measures of expediency, I should say. I think that is a question entirely for the Board.

1907. Well, but you were Manager?—Oh, I had nothing whatever to do with Zuurbekom.

1908. Cannot you answer the question?—No, I cannot.

1909. Do you know anything about the prices charged for water?—Yes.

1910. Can you tell us what was charged when you came here?—Ordinary supplies, 10s. per thousand.

1911. Oh, the same as at present?—Yes.

1912. Don't you think the consumption of water would be increased if the price were reduced?—That is very doubtful. I think not, under the circumstances. Any individual will use all the water he requires.

1913. Although he has to pay 10s. per thousand gallons?—Yes, or even more.

1914. You think that is not a prohibitive price?—No.

1915. Do you think there will be any larger consumption per head when there is a larger population?—I see no reason to anticipate it.

1916. You have seen the statistics placed before the Commission on that subject?—Yes.

1917. You don't agree with them?—Not at all.

(*The Chairman.*) What statistics?

(*Mr. Lance.*) I mean those of American towns.

(*Witness.*) I may say on that point that the experience of one very large town in America goes to prove the contrary.

1918. (*The Chairman.*) What town was that?—The town I refer to is Fall River, where the consumption in 25 years with 6,000 leads to start with was 80 odd gallons per day per head, and in 25 years it went up to 98,000 leads with a consumption of 35 gallons per head.

1919. (*Mr. Lance.*) What was the class of population of that town, were they not a large labouring and mechanical class?—I do not know.

1920. Do you know anything of the nature of the population of that town?—No.

1921. In your returns you show the capacity of the reservoirs; you give No. 3 as having the largest capacity?—Yes.

1922. Which is that? Is that one in New Doornfontein?—Yes, the higher one.

1923. On the northern side of the railway, that is the largest reservoir you have?—Yes.

1924. Does surface water flow into that?—Nothing flows into it at present. It is not in use.

1925. Oh! then the largest reservoir you have is not in use?—It is not necessary.

1926. But as a matter of fact the surface water has been flowing into it?—Well it may have in the course of history.

1927. I mean lately. Do you exclude surface water from it?—It is absolutely out of use in every respect. Nothing can flow into it.

1928. I think your returns show you are pumping more water than is distributed?—That is very natural.

1929. What becomes of it?—The water is pumped a good many times over in many instances.

1930. (*The Chairman.*) I did not quite catch your meaning?—The water is pumped over more than once, sir.

1931. The same water?—Yes.

1932. The same water; how does this come about?—In the first place we lift it from Zuurbekom to Paarlshoop, and then from Paarlshoop to town.

1933. Then your pumping returns are practically double the actual quantity of water that goes into town?—In many cases.

1934. I do not understand that. It leaks I suppose?—There is a certain amount of loss on the road.

1935. Are you quite clear about that? Do you really mean to say that the gross return of water pumped, which you give, was a return in respect of first pumping from Zuurbekom to Paarlshoop, and then another return from Paarlshoop to town without discrimination?—I do not think I have given any pumping returns.

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1936. Then it only means half of your pumping return, because you pump water twice?—I think you will find, sir, I have given the distribution.

1937. It was your last answer that rather upset me?—I am only answering Mr. Lance's question.

1938. I think your return is headed "yield at stations?"—Yes, one of them.

1939. Do I understand, if you had given any figures about pumping, they would have had to be divided by two to give the amount of water distributed?—Roughly speaking, yes.

(*The Chairman.*) I see.

1940. (*Mr. Lance.*) You say you differ from Mr. Andrews on amount required for street watering?—Yes.

1941. You think a good deal less is required than is stated in his evidence?—Yes.

1942. Your experience, as regards street watering, has been gained in England?—Yes.

1943. Where a good deal less is required than in this climate?—Yes.

1944. You have quoted the instance of Paris, and you say that ought to be taken as a basis?—I mean the principle of so much per square yard, and not so many gallons per head.

1945. Did you say that amount ought to be sufficient?—In my opinion it is.

1946. So that the amount you state for street watering here is the same amount as is used for street watering in Paris?—Yes, where, I understand, they water the streets very liberally.

1947. There are a great many more days on which rain falls in Paris than here, are there not?—Probably.

1948. Then you mean water is wasted on street watering in Paris?—No, I would not say so.

1949. Then does it not follow that more should be used here in the course of a year?—To a certain extent.

1950. Can you give us some idea of how much?—No, I do not profess to be an authority on the subject.

1951. Well, you do by criticising our figures?—I consider two gallons per head would be quite sufficient to use.

1952. Yes, but that two gallons per head represents the same amount of water put on the streets in Paris?—Thereabouts.

1953. So that we can draw our own conclusions as to the value of it. Your Company is an Estate as well as a Waterworks Company, or has been?—That is a matter of which I have no cognisance of.

1954. You are the Manager?—Pardon me, I am aware of the fact. It is, however, an Estate Company as well as Waterworks.

1955. As a matter of fact you are Manager of the Company, are you not?—I am Manager of the Waterworks.

1956. And you know nothing about the Estate?—Nothing whatever.

1957. We had quotations this morning as to the quantity of sewage discharge. Is that correct? I think it was stated that 30 gallons per head was a fair amount to take as the discharge of a city?—I have not gone into the matter for the present occasion and cannot answer your question.

1958. You were talking of Paris just now. Do you know the total consumption per head there?—I believe about 30 gallons.

1959. Is it not 65?—I cannot speak from knowledge.

1960. Then you do not know?—No.

1961. You speak in your returns of certain districts being closely populated. Do you know how many there are per acre in those districts?—No, I have not worked it out.

1962. Do you think the definition is a correct one?—When I say closely populated I refer to stands being more or less taken up and built upon.

1963. Yes; you mean relatively. The present mains you have in town, Mr. Raynes, would they be sufficient for an enlarged supply?—Not a very large extra supply.

1964. They have been in the ground for a good many years?—Yes.

1965. And they were intended for even a smaller supply than you are giving now?—Yes.

1966. So that if any new supply of a large amount of water existed the present mains would hardly come in at all?—The service mains, those of which the leads are taken, generally speaking, are about sufficient, but it would be necessary to lay down fresh trunk mains.

1967. Of course, you are well acquainted with the Zuurbekom works. Can you tell us which shaft your engine-house is on?—The engine-house is on No. 1.

1968. Is that shaft yielding most water?—Not at present.

1969. Did it yield most at any time?—No.

1970. Can you tell us why the engine-house was put there?—No. I think this is a question for the Consulting Engineer to answer.

1971. Yes, but the Consulting Engineer generally refers us to you?—I have already explained that I have nothing to do with the Zuurbekom works other than managing them.

1972. Do you know how the pumping affects the level of the water in the wells?—Oh, yes.

1973. I think we have had that before. Have you any idea of the cost of this new engine-house?—No, that does not come within my province at all.

1974. Do you know the indicated horse-power there now?—Roughly speaking, about 100.

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Mr. Thos. Raynes

January 20, 1902.

1975. About 100 what?—Horse-power.

(*Mr. Thomson.*) Surely this is a matter that would come before an Expropriation Commission?

(*The Chairman.*) What, the actual horse-power? It seems a very harmless question. I doubt whether we shall ever get to expropriation.

(*Mr. Thomson.*) But that is the tendency of the question.

(*Mr. Lance.*) All through we have been going into the question of the cost of works, and so on.

(*The Chairman.*) I do not think anything of this kind depends on expropriation, and Mr. Lance has to satisfy his curiosity with Mr. Raynes, as you decided not to take advantage of the opportunity of putting one of the Directors into the witness-box.

1976. (*Mr. Lance to witness.*) Can you give us any particulars as to the terms on which you hold the land at Zuurbekom, as to those 12 morgen. How is it distributed?—No.

1977. You cannot; and I suppose you can give us no information as to why the Company in the past has not met the requirements of the town?—I do not commit myself as to the actions of the Company in any way in the past.

1978. (*The Chairman.*) Do you get all your water now from Zuurbekom?—Practically.

1979. What do you mean by practically?—The great majority of it comes from Zuurbekom, but in case of shortage we have to make up the difference from the stations in town.

1980. I want you to explain what are the stations in town. Does that mean Doornfontein?—Yes, it is all in Doornfontein. It consists of a well and two bore-holes.

1981. I do not know whether you care to answer my next question, viz.: What kind of water is it that comes from Doornfontein, is it surface water?—It comes from below the bottom in each case.

1982. What proportion do you suppose you take from that?—A very small proportion indeed. I should say not more than 10 per cent.

1983. On an average throughout the year?—I should think so.

1984. I suppose there never is a year that you do not have to draw on that water?—No.

1985. Although, as a matter of fact, I think from what came under our notice your pumps at Zuurbekom are going in a very easy manner just now?—Yes.

1986. They could easily be screwed up a bit?—Yes.

1987. You do take water from Doornfontein?—Yes.

1988. You think about 10 per cent. I wish you to explain one of these figures to me. In your returns of pumping and distribution for 1900, for instance, you have got nearly 800 million gallons pumped—794 to be correct—and your distribution was 262 millions. So that is less than a third of what was pumped. I want to know how you make up the gallons pumped. Is it by adding up the work done by every engine?—Yes.

1989. That of course would explain matters?—It depends how many subsidiary stations have been in use.

1990. Then the average pumping means nothing?—No.

1991. It only shows the engineer what has been done?—Yes.

1992. And what we go on is the number of gallons distributed?—Yes.

1992*a*. Would that mean actually distributed to the consumers and charged for, or distributed from the mouth of the pump?—From the mouth of the pump.

1993. And it would include wastage?—Yes.

1994. Why I ask is, that from the table* it would appear that the Zuurbekom water sent to Johannesburg in 1900 was about 221 million gallons, whereas the distribution amounted to 262 millions, and I see now you explain that the difference is drawn from Doornfontein. These town stations, as you call them in your first return, Nos. 1, 2, 3, 4, and 5, are they all at Doornfontein, because I don't understand your system?—No. 1 is situated in the corner of the poort next Doornfontein.

1995. Drawing water from all sources?—No, there is a spring there which we regularly measure.

1996. Is there a lifting pump?—There is a pump, but it is not in use.

1997. You have two steam pumps there you say.

(*Mr. Thomson.*) Mr. Chairman, if you will allow me, this diagram† will show you all the town stations.

1998. (*The Chairman.*) These are the reservoirs, and I was asking about pumps. I think I will get Mr. Raynes to answer my question. You have got that table I am referring to, Mr. Raynes?—Yes.

1999. As to No. 1?—These pumps are for the purpose, when necessary, of lifting the water from No. 1 reservoir to the high service reservoir. We do not use them except on emergency.

2000. Quite so, and you don't use them except on emergency. Then as to No. 2?—This is the Doornfontein well from which we pump to No. 1, and from No. 1 it is distributed to the town.

2001. Then No. 3?—The same applies. It is also in Doornfontein.

2002. No. 4?—It is adjacent to No. 3.

2003. No. 5?—This is the station down the Bezuidenhout Valley, about three miles distant, but not in use at the present time.

* See Appendix G. 3.

† Not printed.

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2004. That is what you use for the Bezuidenhout water when you do get it?—Yes.

2005. Then these are not really of much importance?—No.

2006. (*Mr. Quinn.*) Will you please look at the table* giving the yield on stations for the six months ending July, 1897. You have all the stations there. In each of these cases does the same thing apply you spoke of some time ago? Is this water twice pumped or are these figures the exact amount of water?—That was the amount of water available.

2007. Was this water taken on the days mentioned?—Portion of it—the greater portion of it.

2008. Because, by adding up the figures on that sheet giving the daily supply for the next twelve months we get an average of over one million gallons per day and, turning to another table for the same year, viz.: 1897, we get a daily consumption of 804,000?—That was only the available water. A portion of that we had to send away to the compensation at Weltevreden.

2009. If it had said "available" it would have been different?—Yield is the amount available.

2010. What sort of water did you find in use when you took over?—Indifferent.

2011. Do you know, Mr. Raynes, or has it ever come to your knowledge since coming into the service that the Weltevreden Works pumping stations, Nos. 1, 2 and 3, were condemned in 1893 by the Engineer to the Waterworks?—I have no access to any of his reports.

2012. But in your opinion don't you think the danger of surface water getting into these reservoirs made them undesirable as storage places for water for human consumption?—I should not recommend them.

2013. Nevertheless they were used until 1898, I think?—Well, hardly, the only one reservoir used continuously or even at intervals was No. 4, into which we pumped good water kept for storage.

2014. A little while ago you said that when you came here you found the charge per thousand gallons was 10s.?—Yes.

2015. What was the minimum charge then?—I believe as low as 6d. per hundred.

2016. What was the minimum rate to householders?—22s.

2017. So that in those days every one was forced to pay at least 22s. 6d. if they had water at all, whether they used 2,000 gallons or 200?—With a discount, yes.

2018. I mean with a discount. That was so?—Yes.

2019. Later it was altered, and you made the minimum charge 10s.?—Yes.

2020. But for a long time the poorer class, taking something like 1,000 gallons per month, were compelled to pay in every case a minimum charge of £1 with the meter rent?—Yes, but they were entitled to use 2,000 gallons.

2021. They could have used 10,000 if they liked?—Yes.

2022. But whether they used 1,000 or 2,000 they had to pay for 2,000 for a long time?—Yes.

2023. Is it within your knowledge that that was the cause of a great deal of discontent in town?—Possibly.

2024. The papers were full of letters about this very thing?—Yes.

2025. (*Mr. Brakhan.*) As to the water which has been supplied to the mines, is that water from Zuurbekom or from other stations?—A large proportion of it is supplied from Zuurbekom.

2026. Partly from Zuurbekom and these reservoirs in the Doornfontein Valley?—Yes.

2027. Has any complaint reached you in regard to the quality of Zuurbekom water for boiler purposes?—None whatever.

2028. And from what you have heard there is no objection to dolomite water being used in boilers?—No; from my own experience, it is excellent water for boilers.

2029. (*Mr. St. John Carr.*) You stated that about 10 per cent. of the water pumped from the Bezuidenhout Valley is pumped up to the reservoir for distribution in town. Is that mixed with Zuurbekom water?—Yes.

2030. And you say this pumping only takes place when there is a shortage from Zuurbekom?—Yes.

2031. Can you say how this shortage arises?—Well, I cannot exactly, but the amount used varies from day to day, sometimes very widely.

2032. I understood that the capacity of the existing pump service at Zuurbekom was one million gallons per day?—Yes.

2033. And the consumption does not exceed one million?—Yes; but you must remember we are executing works out there, and it is not always possible to pump our total.

2034. It arises then on account of these works being carried on?—Yes.

2035. Then you stated with regard to the price at present being charged that you did not consider it prohibtive. You have had experience of the prices charged elsewhere?—Oh, yes.

2036. Do you think there is any other place you can mention where the price is so high?—Not to my knowledge.

2037. (*Mr. Rouliot.*) Mr. Raynes, there is only one point on which I should like to be perfectly clear. It has been stated that you have either erected or have in course of erection at Zuurbekom two engines each capable of delivering one million gallons per day. Now is that delivered in Johannesburg?—Yes.

2038. So that the pumping capacity on the two engines is slightly superior to one million gallons each per day?—The pumping capacity of the two engines is equal to two million gallons.

* See Appendix G. 3.

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Mr. Thos. Raynes

January 20, 1902.

2039. Yes, but is it two millions delivered in Johannesburg?—At the present time, no.

2040. But they are intended to deliver two millions in Johannesburg and therefore the pumping capacity at Zuurbekom is slightly more than two millions?—Yes.

2041. What is about the proportion do you think?—I should not like to state that off hand, however it it slightly bigger.

2042. The only point I wanted to make clear was whether these two millions were two millions delivered in Johannesburg?—They would be if we had the water.

2043. If you had the water?—I mean to say if the works were in such a condition that we could take the water.

2044. Then according to the figures submitted to us it is contemplated that ultimately you might increase your pumping plant so as to deliver up to five million gallons in Johannesburg. Would your present mains carry that amount of water?—It is not intended they should. It is intended to lay down a secondary main in order to enable us to do so.

2045. I mean for distribution in the town?—Oh, no, certainly not.

2046. So that you would only have to relay the mains?—A certain portion only.

2047. And for two millions?—It would doubtless be advisable to enlarge some.

2048. You said a great proportion?—Oh, no, a very small proportion.

2049. At what would you put it down?—I should not like to say without going into the matter, but quite a small proportion.

2050. (*Mr. Kitzinger.*) Did I understand you to say street watering is done here in the same way as it is done in Paris?—No.

2051. There was some comparison with regard to street watering made by you between Paris and Johannesburg?—I cited Paris merely as an example as to how much was necessary.

2052. And at what figures did you arrive?—I arrived at about two gallons per head.

2053. And what is the proportion used for street watering in Johannesburg in the past per head or at the present time?—I have not worked that out but it is very small.

2054. Very small?—Yes.

2055. Did you not say it was on the same rate per head as in Paris?—Oh, no.

2056. Then what was the comparison you did establish between Johannesburg and Paris?—That somewhere about the amount used in Paris would be sufficient for Johannesburg.

2057. It would be sufficient, but at the present moment it is not anything like the same?—No, nothing like it.

2058. You said in your statement at the last meeting that at the present moment outside of Zuurbekom you could supply half a million gallons per day?—Yes, when the occasion arises.

2059. May I ask where that comes from?—It comes from Doornfontein stations and Weltevreden.

2060. Would you at all times be able to pump that quantity from these two sources if the necessity arose?—Generally speaking we would.

2061. You do not anticipate the occasion will arise?—No.

2062. (*The Chairman.*) Just one question to clear up what I asked you before, as to this mixture of Doornfontein and Zuurbekom water. How does it actually take place, in the high service reservoir?—No, in No. 1 reservoir.

2063. That is half way up the hill?—Yes.

2064. I see. If you notice your reservoirs going down very rapidly, do you then put in Doornfontein water? How do you actually decide?—We decide by the state of the high service reservoir.

2065. What happens under normal conditions, I suppose, is, that the pumps from Zuurbekom keep it practically full?—We keep it at an ordinary level and by the state of that level either higher or lower we know how much is being used, or rather the rate of consumption.

2066. It is being watched all day long?—Certainly.

2067. And then this Paarlshoop, it is simply a pumping station on the way. If you find the high reservoir going down too much, what happens? Does the pump always keep going at Doornfontein?—Oh no, not always but pretty frequently.

2068. Did you ever have any bacteriological analysis made of your Doornfontein water?—Oh, yes, by Dr. Levy, and the result was very favourable.

2069. How often did you have it done?—At no stated periods.

2069*a*. Not once a week?—No.

2070. Does the Medical Officer for Health in Johannesburg take samples?— He used to.

2071. You don't know if he does so now?—No, I know nothing of his movements.

2072. When was your last analysis taken?—In 1898.

2073. As far as you are concerned you have not taken one since?—No.

(*The Chairman.*) Thank you.

(*Mr. Thomson.*) Before going on with Mr. O'Reilly's evidence, Mr. Stewart has prepared for the information of the Commission a diagram* showing the monthly rainfall since 1896 at three different stations.

(*The Chairman.*) Thank you, we shall be very glad to have it.

(*Mr. Thomson.*) It is information contained in his statement but it will be easier to follow the diagram.

(*The Chairman.*) I see, thank you.

* Not printed.

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Mr. JAMES PAUL O'REILLY, called and further examined:

(*Mr. Thomson.*) Mr. O'Reilly has prepared a statement which he can put in later on.

(*The Chairman.*) I think it would be better to put it in now. Is it what we already have, or another one?——

(*Mr. Thomson*) It is giving the information asked for.

(*The Chairman.*) Can I see it, as I wish to see whether it should be read out or not.

(*The Statement was handed in.*)

(*The Chairman.*) Perhaps you would like to read that statement, Mr. O'Reilly?

(*Mr. Lance.*) I take it the Commission will be furnished with a copy of this.

(*Mr. Thomson.*) Yes.

Mr. O'Reilly read the statement as follows:—

Extract from the Minutes of a meeting of Directors of the Johannesburg Waterworks Estate & Exploration Company, Limited, held at Johannesburg on the 18th January, 1902:—

The statement submitted for the signature of the Secretary and to be handed to the Water Supply Commission in accordance with the request of the Chairman of the Commission for a statement showing the price at which water is supplied to the public, having been read, it was resolved that the same be approved, that the Secretary be authorised to sign the same, and that it be handed to the Commission at its next sitting.

Johannesburg, 18th January, 1902.

For the Johannesburg Waterworks Estate and Exploration Company, Limited,

(Signed) J. P. O'REILLY,
Secretary.

With reference to the request of the Commission to be supplied with a statement showing the charges made by the Waterworks Company for the supply of water to Johannesburg, I am directed by the Board to hand in the accompanying statement, giving the scale of charges for water supplied to the inhabitants of Johannesburg, by meter, since the formation of the Company, from which statement it will be seen that as the supply of water has increased the prices charged have been considerably reduced.

Owing to the fact that the charges for water supplied are only recoverable from the actual consumer, and are not chargeable against the property in respect of which it is used, and owing to the large floating population of Johannesburg, the revenue from the supply of water is considerably reduced, and the charges, therefore, cannot be considered as excessive.

To show this, I annex a statement giving the amount of dividends paid by the Company since 1889, from which it will be seen that the return to shareholders upon their capital is not adequate in a place like Johannesburg, especially when taken in comparison with other investments in the place. It should also be borne in mind that the present demands of Johannesburg for water do not amount to 1,000,000 gallons per day although the Company is in a position at present to supply double that quantity, and will very shortly be able to double that again, from Zuurbekom alone—a large amount of capital having been expended on Capital Account for the purpose of providing the increased supply.

The Company has reached that stage at which the shareholders expect to reap the fruit of their labours by receiving increased dividends upon their outlay, and it will also be possible for the Company to make reductions in the charges for water supply if the quantity consumed is considerably increased. If the quantity taken by the town is not less than 2,000,000 gallons per day, the Company would be prepared to supply the same at considerably reduced rates per thousand gallons; and if not less than 4,000,000 gallons are taken, the Company would be prepared to supply the same at a still lower rate.

If the Town Council in future is prepared to take water in bulk from the Company in quantities of from 10 to 15 million gallons a day, the Company will supply it under 2s. 6d. per 1,000 gallons; of course, sufficient time to construct the necessary works to be given, and subject to provision being made for the rights of riparian owners by legislation.

The Company is prepared to find all moneys required for the execution of above extension of their works, without any Government guarantee of interest on debentures.

JOHANNESBURG WATERWORKS, ESTATE AND EXPLORATION COMPANY, LTD.

Charges for Water by Meter since the formation of the Company.

1889—1892. 1/6 per 100 gallons for any quantity, plus 5/- monthly meter rent.

1893—1895. 1/6 per 100 gallons, plus 5/- monthly meter rent. Minimum 35/-.

1896—1897. 1/- per 100 gallons and 5/- meter rent for any quantity up to 5,000 gallons. Over 5,000 gallons, 10d. per 100 gallons. 100,000 gallons and over, 10d. per 100 for first 100,000 gallons, 8d. for second or part thereof, and 6d. per 100 for all over 200,000 gallons. Minimum £1 : 5/-.

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Mr. J. P. O'Reilly

January 20, 1902.

1897—1899. 1/- per 100 gallons and 2/- meter rental monthly for all up to 5,000 gallons. Quantities above 5,000 at same rates as 1896-1897. Minimum £1 : 2/-.

1899. 1/- per 100 gallons, plus 2/6 monthly meter rent for all up to 5,000 gallons. Quantities over 5,000 gallons at same rates as 1896-1899. Minimum 12/6.*

Water for Municipal purposes 3/6 per 1,000 gallons, and for Municipal Fountain 2/6 per 1,000 gallons. Water supplied to Government and Military, 5/- per 1,000 gallons.

JOHANNESBURG WATERWORKS COMPANY.

Dividends Paid.

	£	s.	d.
No. 1 of 7½ per cent. February, 1889	10,022	8	6
No. 2 of 5 per cent., September, 1891	9,250	0	0
No. 3 of 5 per cent., August, 1892	10,000	0	0
No. 4 of 6 per cent., September, 1893	15,000	0	0
No. 5 of 6¼ per cent., September, 1894	15,625	0	0
No. 6 of 7½ per cent., August, 1895	18,742	10	0
No. 7 of 7½ per cent., August, 1896	37,500	0	0
No. 8 of 7½ per cent. July, 1897	37,492	10	0
No. 9 of 7½ per cent., June, 1898	37,500	0	0
No. 10 of 5 per cent., June, 1899	30,000	0	0
	£221,132	8	6

2074. (*Mr. Lance.*) Mr. O'Reilly, you have been Seretary of the Company for a long period, have you not?—Yes.

2075. Since when?—Since 1890.

2076. And the Company has until quite recently been an Estate Company as well as a Waterworks Company?—Yes, until 1896.

2077. Was it in 1896 that the Estate was transferred?—Yes.

2078. Throughout the time that you have been Secretary, or at all events until Zuurbekom came in, you know there was a considerable shortage?—I know there were complaints.

2079. You know there were a great number of complaints?—Yes. Prior to Zuurbekom there were complaints.

2080. Complaints were filed both as to the quantity and the quality of the water, were there not?—At times, yes.

2081. Can you give us any idea or any reason why the Company for that long period did not remedy matters by getting a permanent supply?—The matter was always before the Directors of the Company. The Directors at the time engaged the best engineers they could procure in the country and acted upon their advice from time to time, as far as I know.

2082. Oh? They acted on engineers' advice did they?—Yes. They were always advised by engineers.

2083. Did you know, Mr. O'Reilly, that in 1893 there was a report from the engineer pointing out that it was absolutely necessary to get a new supply of water?—In 1893, it is quite possible.

2084. Did the Company act on that?—Oh yes. In order to secure an adequate supply for a town like Johannesburg, it takes a considerable time. The country would have to be examined all about Johannesburg, and it would take some years before you could get a proper supply.

2085. At all events nothing was done until Zuurbekom was brought in?—As I said, the Directors always had the matter before them.

2086. They had the matter before them, and yet they did nothing?—I am not prepared to say that.

2087. They looked at the matter from the shareholders' point of view, and were not going to run any risks. Was that not it?—I do not understand that, Mr. Lance.

2088. Did not the Directors look at the matter from the shareholders' point of view, and decided they were to run no risks as regards the supply of water?—No unnecessary risks, I suppose that would be so.

2089. They were under no obligation to supply water?—They always felt there was such an obligation on them to supply the people of Johannesburg with water.

2089*a*. Oh, they did?—Yes.

2090. In 1898 when they were pumping the Zuurbekom water, were you not short in the dry season?—No.

2091. Were you not calling on the people not to use water for their gardens?—After Zuurbekom. Certainly not.

2092. Not at all in the dry season of 1898?—No.

2093. Can you give us some particulars as to how the land at Zuurbekom is held. The 12 morgen has been referred to, can you give us any particulars as to it?—Rights in regard to the land on Zuurbekom are held by the Zuurbekom Water Company.

2094. Yes, but can you tell us what amount of ground you have, and where it can be taken?—All the rights are in the hands of the Zuurbekom Water Company.

* Discount of 10 per cent. off accounts of over £1 sterling for water supply, if paid within seven days after account has been rendered.

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2095. You cannot give us any particulars from your own knowledge?—As a matter of fact, I think you are about right in stating the extent to be from 10 to 12 morgen.

2096. Is there anything to prevent others putting down shafts in your immediate neighbourhood?—In the immediate neighbourhood of Zuurbekom?—Yes.—I am not prepared to say at the present moment.

2097. (*The Chairman.*) With regard to this statement you have just put in you say "That as the supply of water increased the price charged was considerably reduced." Do I understand you to mean that there has been a progressive decrease in the price as the consumption has gone up?—The minimum has been reduced, Mr. Chairman.

2098. "The prices charged have been considerably reduced," is your remark, but I see you mean the minimum only and the meter rent, and the only difference in price to the ordinary consumer is from 15s. per 1,000 gallons to 10s. per 1,000 gallons. In the next paragraph you say, "Owing to the fact that the charges for water supplied are only recoverable from the actual consumer, and are not chargeable against the property in respect of which it is used, and owing to the large floating population of Johannesburg the revenue from the supply of water is considerably reduced, and the charges therefore cannot be considered excessive." The conclusion is that you make a lot of bad debts?—Yes, we do.

2099. Can you give me any idea of the total sum lost by the Company in this way? Don't answer if you do not wish to?—I have not got a statement prepared.

2100. You say it is a very important item? —Yes.

2101. Something I suppose which would materially affect the gross revenue of the Company?—It would affect the revenue.

2102. Of course it would, but I say "materially"?—It all depends what you understand by "materially."

2103. So materially, that as you say, the charges could not be considered as excessive. That is the next phrase used by you?—It would be under 10 per cent.

2104. That, in the opinion of your Board, is a material factor in keeping the price of your water at 9s. to 10s. per 1,000. If you could collect your debts with more regularity you would be able to bring it down without decreasing the profits of the shareholders? —If we had the security of property, yes.

2105. If you collect your debts. It comes to the same thing. How large an amount would you say?—I cannot answer that without reference to the Board.

2106. Still we may take it that 10 per cent. of your gross revenue disappears because people don't pay their just debts to the Water Company?—I cannot say exactly without reference, but the amount would be under 10 per cent.

2107. You also put in a statement as to the amount of dividends paid by the Company from which it will be seen you state that the return to the shareholders is not adequate in a place like Johannesburg. I think the dividends range from 5 to 7½ per cent.?—Yes.

2108. There is one rather important factor in the question of returns to shareholders, and that is the amount of capital, is it not? —Certainly.

2109. Supposing, for instance, you were grossly over capitalised, you still might be earning a very handsome profit, and the apparent dividend would be small?—Undoubtedly.

2110. I call your attention to what the Concessions Commission say on that point, "Very high prices," say the Commission, "seem to have been paid for the acquisition of Doornfontein and other water rights," and also "That these figures include high promoters' profits is suggested by the terms of the following section, which we quote *in extenso* from the Company's Statutes without comment." I think there is a very broad imputation in that quotation from the Concessions Commission's Report that if there had not been high promoters' profits, shareholders might be getting more than their capital now. Don't you think so? Perhaps you would not like to answer that question?—I could not reply to that without reference to the Company's records.

2111. No, certainly not, but you can see that the Commissioners have taken the view of the relation of dividends to capital?—Yes.

2112. Now, just as a matter of fact, you say the Company is at present in a position to supply 2,000,000 gallons. That is not strictly accurate, is it? You have not got the pump there?—We are erecting the pump now.

2113. No, I have had the pleasure of seeing the works, but it is not strictly accurate?—Not at the moment, from Zuurbekom alone but from all other sources, I think.

2114. Oh, I see. You are in a position to pump another 1,000,000 gallons from Weltevreden and Doornfontein?—I think the engineers will bear out the figures given.

2115. It follows from the maximum capacity of your engines at Zuurbekom that you contemplate the possibility of giving say, 50 per cent. of Weltevreden and Doornfontein water to make up the 2,000,000 gallons if required?—That would be so, I take it.

2116. You say that "A large amount of capital having been expended on Capital Account," for the purpose of providing an increased supply at Zuurbekom, I suppose? —The figures are public, but the amount spent under capital account at Zuurbekom has not been made public.

2117. Yes, don't answer if you do not like to, I imagine we have got it from Mr. Stewart?—The amount has not been published of the expenditure up to date.

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2118. No. Of course we have had from Mr. Stewart practically what it cost. You expect a still further increase of dividend on this capital and at the same time you propose to make a very considerable reduction if the quantity consumed is considerably increased?— Yes.

2119. You are not prepared to state what reduction the company is prepared to make if the 2,000,000 gallons were taken? All they say is that it would considerably reduce the rates?—I cannot say anything further without reference to the Board.

2120. It is not until we come to from 10 to 15 million gallons that the Board is prepared to consider its maximum. Is not that so?—Yes, the Company makes a definite offer there, when the consumption reaches 10 to 15 million gallons.

2121. You use the phrase "under 2s. 6d." I suppose it really means that would be the maximum?—It means something under 2s. 6d.

2122. As the maximum? - Yes.

2133. I suppose a kind of sliding scale to suit consumers?—No, it would be something under 2s. 6d., if supplied in bulk to the Town Council.

2124. Oh, yes, in bulk, I beg your pardon. I see what you mean, but I did not understand for the moment. You mean that if you are saved all the cost of distribution throughout the town and merely supply from the reservoir, and the Town Council take all the cost of distribution with that, you would sell to them at 2s. 6d.?—Yes, 2s. 6d. at a given point.

2125. That is the intention of that phrase? —Yes.

2126. That point would be somewhere within the Municipal area, probably the high service reservoir?—I should think so.

2127. Then the position is that if the Company is allowed to sell double the quantity, *i.e.*, 2,000,000 in a year's time, it will supply the water at considerably reduced rates, but you would bind yourself to nothing very definite, and having done that the Company will get the increased dividend it considers its right. That 2,000,000 gallons would be supplied without any increase in plant, because you have got your plant coming out, and then, too, you can use 50 per cent. of Doornfontein and Weltevreden water to make it up?—The plant is being erected at present.

2128. Yes, but in any case you have already bought and paid for that plant, so that to give us 2,000 gallons will not entail extra expenditure?—Of course we are spending money now.

2129 Yes, but on producing water at 9s. per 1,000 gallons?—We are spending money very largely in the erection of additional plant at Zuurbekom.

2130. Yes, but that is all coming out of the Capital Account, and all amounting up to a certain sum?—Yes.

2131. Let me understand about this 2,000,000 gallons. Would that mean in bulk or in individual consumers?—That would mean the individual consumers.

2132. Quite so, but how are you going to work that out? Are you going to give a rebate to each consumer, because until you satisfy yourself that your consumption has reached 2,000,000 gallons of course you will charge the old rate?—Once the daily average consumption reaches 2,000,000 gallons in town the Directors will consider the advisability of reducing the tariff.

2133. Oh! Consider the advisability, that is a different matter altogether, or have you undertaken to reduce the tariff? I mean in the latter case it would pay the Johannesburg householders to let the water run utterly to waste for one day and then your Directors would have to decrease the rate. Tell me how you work it out?—Once the engineers report that the daily average consumption has reached 2,000,000 gallons the Directors would then reduce the tariff, and probably announce that in the public papers.

2134. I see. You wait for a certain period and take the average consumption. When you say "town," would that mean the mines in addition to the town?—No, it would only mean the town.

2135. Tell me how you actually find out what quantity the mines and what quantity the town takes. I suppose you have meters and keep a sort of ledger account?—Yes.

2136. So by adding up these various accounts of the mines and subtracting from the total, the difference represents what the town has taken?—Quite so.

2137. What do you do now in regard to the mines? Do you quote them special terms?—Yes.

2138. What difference would it amount to?—In certain cases, some of the mines are supplied at as low a rate as 3s. 6d. per 1,000 gallons.

2139. There is nothing to restrict them from using that for their employés, or anything of that kind?—Oh no.

2140. I see. Then we are to understand this statement you have put in to mean that, as soon as your engineers have seen that the consumption of the town has increased beyond 2,000,000 gallons per day, the Company will then consider the advisability of publishing a rate considerably less than 10s., and when the consumption goes up to 4,000,000 gallons, the Company will make a further reduction?—Quite so.

2141. But you are not prepared to give any indication as to what that reduction might be?—Not without reference to the Board.

2142. Then there is an entirely different proposal of selling to the Town Council in bulk. Supposing we were to engage in this business ourselves, have you any idea what it would cost to supply ourselves with 10 or 15 millions per day? Do you think we could do it for 1s.?—I could not tell you.

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2143. I rather fancy we shall have evidence that we could do it for 7d., apart from the cost of the water site. Instead of supplying ourselves for 1s. we are to ask you to do it for 2s. 6d.?—Yes, provided you take the quantity.

2144. It hardly seems to be an advantage to the town, unless our engineers are all wrong, because you have faced us with the awkward fact in your supplementary statement that you are going to increase your dividends at the same time, and what will naturally occur to the Commission is whether we should not pay these dividends into our own pockets. I put it to you, as I should like you to explain to the Commission where the advantage to the town would come in, in accepting such an offer. I would also call your attention to the fact that we are face to face with this conclusion of the Concessions Commissions' Report:—"We consider, in view of the objections substantiated above, that the continuance of this concession in its present shape is contrary to public interests." It is rather a nasty corner to get round, and I think it only fair that you should have an opportunity of explaining to us where our advantage would come in?—The advantage would come in with the quantity of water. If that offer were accepted, the quantity would be guaranteed by the Company to the town, who would be saved the necessity of looking for water.

2145. We have a gentleman in the room willing to give us 10,000,000 gallons. When we want it, I do not think we shall have to look very far. The evidence we have had before us is that there is water near at hand. At any rate, that is the only ground you can put forward—or, rather, you are instructed by your Board to put forward, because you are here as the mouthpiece of the Board?—Exactly.

2146. (*Mr. Kitzinger.*) I think you refused to answer a certain question put to you on the plea that it does not refer to your Board, but to the Zuurbekom Company. There was a question put to you in regard to the Zuurbekom Waterworks Company?—I did not refuse to answer, Mr. Kitzinger. I merely said that the titles of the ground were held by the Zuurbekom Company.

2147. In the evidence given before the Transvaal Concessions' Commission, it was stated by one of the witnesses, on appearing for your Company, that all the shares of the Zuurbekom Company belonged to the Johannesburg Company. Who is the Secretary of the Zuurbekom Water Company?—The Consolidated Investments Company, Limited.

2148. You have nothing to do with it?—Nothing beyond the fact that we are very large shareholders.

2149. The evidence went further, and said that all the shares belonged to the Johannesburg Waterworks Company. Can you not tell us the exact area of ground held by the Zuurbekom Water Company?—The ground held by the Zuurbekom Water Company is about ten or twelve morgen—for erection of buildings, plant, &c., with the sole right to take all the water found by boring or sinking on the whole of the farm Zuurbekom.

2150. The remainder of the farm belongs to outsiders?—Yes.

2151. Can you tell us who is the owner of the farm?—It belongs to Le Roux and others.

2152. The original owners, I think?—Yes.

2153. I think you stated in your evidence that in April, 1896, your Company ceased to be the owners of the estate?—Yes.

2154. Can you tell us what the consideration was for the transfer of the estate to the other Company?—It was 166 odd thousand shares in the Consolidated Investment Company.

2155. These I take it were distributed amongst your shareholders by way of bonus?—Yes.

2156. The share capital of your Company at that date was £500,000?—Yes.

2157. So taking the present Market value of these Consolidated Investment Company's shares, six years ago the shareholders had their value back. Taking the Consolidated Investment shares at £3 the shareholders had £500,000 six years ago, so that, anybody with shares at par has been repaid long ago and is enjoying dividends now on what has cost him nothing?—The Consolidated Investments Company's Shares were distributed, that is quite right.

2158. There is another question. You said in your evidence that you have a good many bad debts. I have looked through some of your published Balance Sheets, and I have not found that you wrote off anything for bad debts. Must I take it this is already deducted from what you show on the revenue side?—Yes.

2159. (*Mr. St. John Carr.*) In your statement you said that the Waterworks Company were prepared to supply water in bulk at a certain point at 2/6 per 1,000 gallons?—Yes.

2160. If the consumption should reach two million gallons?—No, ten to fifteen million gallons per diem.

2161. Oh, ten to fifteen. Can you give us any idea of what the cost of distribution is now?—No, that is a matter for the engineers to reply to.

2162. Then you speak about the charges being considerably reduced if the town takes two million gallons a day?—Yes.

2163. As a matter of fact, the pipes are not capable, are they, of conveying two million gallons per day?—Oh yes, I think they could supply two millions per day now.

2164. Can you tell me approximately how many shareholders there are in your Company?—From 1,500 to 1,800.

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2165. Between 1,500 and 1,800?—I am not quite sure, but it is about that I should think.

2166. (*Mr. Quinn.*) Just one or two short questions, Mr. O'Reilly. It has been stated by one of the witnesses, one of the experts, that the Waterworks Company has found, since you reduced the minimum to 1,000 gallons, that a large number of people do not even use one thousand gallons?—Yes.

2167. So that it follows, seeing the minimum charge for one thousand gallons was only brought about in 1899, that from the beginning of your operations to that date you compelled a large number of people to pay for twice the quantity of water they had. If a large number of people are found to use less than one thousand gallons, then there were all these years during which you were compelling them to pay for two thousand gallons as a minimum quantity, compelling them to pay for more than twice as much water as they used?—That was the price at which the Company could afford to supply water at that time.

2168. Yes, but they did not supply the water. If the people had been getting the water the minimum would not have mattered so much. Subsequent experience has proved this. People do not use one thousand gallons per month, and therefore all that time in previous years they were compelled to pay for twice as much water as they were getting. That follows, does it not?—A number of people were, certainly.

2169. Who were the vendors of that purchase in 1895, the quarter of a million which was paid in July, 1895, to purchase the water rights on the farms of Steenkopjes and Weltevreden?—Steenkopjes was bought from Mr. Sherwell, Wolvekrans from Mr. Sherwell also, while Weltevreden, I think, was purchased from Mr. Van Hoeven.

2170. In your capacity as Secretary did it come before your notice that your Engineer of these days strongly advised your Company not to buy Weltevreden as it would not be a proper thing to do?

(*Mr. Thomson.*) Is this a question that bears on the Commission in any way. I take it what Mr. Andrews may or may not have advised is a confidential matter.

(*The Chairman.*) Don't you think Mr. O'Reilly is capable of taking care of himself. If he does not wish to answer the question he can refuse to do so.

(*Mr. Quinn.*) I think it is a thing we ought to know.

(*The Witness.*) I would have to look up the records.

2171. I possess a copy of the report which I understand was sent in, and that is, perhaps, sufficient for me now. Who are the biggest shareholders in the Waterworks Company at the present moment?—Barnato Bros., The Consolidated Investment Company, and others.

(*The Chairman.*) The question was put to you, Mr. Thomson, as to whether you intended to put a Director into the box. I do not think any answer was given to it.

(*Mr. Thomson.*) It is not my intention to put any one of the Directors into the box as a witness. The statement put in was intended to show the evidence that the Directors confirm.

The Commission then adjourned.

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WITWATERSRAND WATER SUPPLY COMMISSION.

MINUTES OF EVIDENCE.

SEVENTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

MONDAY, 27TH JANUARY, 1902.

Present:

W. ST. JOHN CARR, ESQ. (ACTING CHAIRMAN).

A. BRAKHAN, ESQ.,
B. KITZINGER, ESQ.,
G. ROULIOT, ESQ.,
W. McCALLUM, ESQ.,
J. W. QUINN, ESQ.,

G. CRAIG SELLAR, ESQ., SECRETARY.

(*Mr. St. John Carr.*) The Government have asked me to take the Chair in place of Mr. Fiddes who is indisposed.

(*The Acting Chairman.*) We will now take the evidence of Mr. Karlson.

Mr. AUGUST KARLSON, City Engineer, Pretoria, called and examined:

2172. (*The Acting Chairman.*) Mr. Karlson, you are City Engineer and Chief Engineer of the Waterworks Company, Pretoria?—Yes.

2173. What is your previous practice as Civil Engineer?—I hold a diploma as Civil Engineer of Stockholm, Sweden. I am a Member of the Technical Institute of Sweden, a Member of the Sanitary Institute and of the Royal Institute of Health, London. I have had eleven years' practice as Railway Engineer and Bridge Constructor in Sweden, France, and the Transvaal, four years on hydraulic and hydrographic work in the Isthmus of Panama, three years as Assistant Chief Engineer to the Municipality of Bordeaux, and four years as Waterworks and City Engineer of Pretoria. I have travelled for a considerable time in Europe and the United States for professional studies. I have made up projects for water distribution and drainage for several other towns.

2174. What is the quantity of water in the Vaal?—I have measured the flow of the river at Standerton and found there 17,000,000 gallons. Below Standerton the Vaal receives—this was in April-May, 1897, and I was informed that the river was not then at its lowest level:—

1. Klip River and Sandspruit;
2. Witrand River;
3. Wilge River;
4. Zuikerboschrand River;
5. Klip River;

besides a number of small spruits which are not even perennial. In my Note* on the Vaal River Scheme I calculated on a total of 100 million gallons at Vereeniging. As none of these spruits are as large as the Vaal this is apparently exaggerated and 30 to 40 million gallons would be much nearer the correct quantity or not much more than the Rand and Johannesburg require—that is, of course, during the dry season.

Mr. A. Karlson. January 27, 1902.

2175. Can the water supply in the Vaal be increased by large storage dams?—This may be possible above Standerton, or rather above the Klip River, where I am not sufficiently acquainted with the country. Below Standerton it is hardly possible; the river in 1894 was at the girders of the bridge at Vereeniging, that is, 13 metres or 43 feet above the low water level. The river beds were flooded at nearly a mile's distance on the Free State side. If a dam is built it could not be lower than 13 metres if it is to be of any use. If the river were confined to the river bed the width of the overflow would be 250 metres. The quantity of water in the river in 1894 was 8,800 cubic metres per second, and this is certainly not the maximum. The height above the weir would be 22 feet 6 inches. No longitudinal dams could be made of this height, consequently the river must be allowed to inundate the Free State side and several places on the Transvaal side to a distance of over one kilometre. The overflow would then be of a length of 1,500 metres, and the overflowing sheet of water would have a thickness of 7 feet. This

* See Appendix H. 3.

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Mr. A. Karlson. January 27, 1902.

would, however, mean that the river banks will have to be bought for a distance of at least ten, probably fifteen, miles. Tunnels through the dam as at Assouan must, of course, be made in order to avoid the silting up of the lake, but the pressure behind not being much greater than on the lower side, these tunnels will not carry much of the flow. Bridges of an enormous length would have to be built or ferry boats established at the two drifts. The dam in itself would probably not exceed £200,000, but with the two bridges or ferry boats and the acquisition of ten or fifteen square miles of ground it will undoubtedly be very expensive. This dam of a height of 13 metres will only store a limited quantity. The fall of the Vaal is 0.0004 per metre. A metre and a half or 60 inches at least will be lost by evaporation. This will leave 11·50 metres. The river will then be dammed up for a distance of eighteen miles. The capacity of the lake will then equal 5,580,000,000 gallons, corresponding for nine months to 20,600,000 gallons per day. Together with a part of the actual flow this would then be sufficient if it is possible to flood the Free State side as high as seven feet above the railway bridge. The flood of 1894 can be exceeded without doubt. Higher up the river one or two dams may be built more easily. In any case the Vaal River Scheme is not as easy as is generally believed, and I also understand this is the opinion of some of the authors of the project who seem to be under the impression that it would be sufficient to acquire water-rights in the Vaal to bring the water to Johannesburg. Private water-rights belong, of course, to the farm they are situated on, and what remains in the river, if it belongs to anybody, ought to belong to the State.

2176. Will the filtration of the water from the Vaal be sufficient for the water supply to the Rand and Johannesburg?—The projected water supply consists of two vastly different natures, water for the Townships and Johannesburg, and water for industrial use. The latter is of course the greater. For this supply a filtration just sufficient to avoid incrustation in the pipes is of course ample; a few microbes more or less in the battery cannot have any influence on the gold. For the Townships, for drinking and domestic purposes, the filtration can also be efficient if the filters are well looked after and only employed when they are "ripe." (See my Note* on Purification of Sewage and Water). The water must first pass through sedimentation basins and thereafter pass through the filter beds with a velocity not exceeding 6 feet per 24 hours. The reduction of the bacteria can then be pushed so far that less than 100 germs per cubic centimetre remain. The dolomite water contains quite as many germs and in certain cases even this purity may not be expected. The difficulty of the higher temperature of the filtered water must not be exaggerated. In this long leading the water may be originally cool or warm; it will more or less take the temperature of the ground. The area of the filter for 30,000,000 gallons per day would be 75,000 square metres at least and the cost according to my more recent calculations £250,000, including, however, the sedimentation basin. In summer time when the Vaal is in flood the filtration may not be sufficient, and a further treatment of the drinking water and domestic supply with ozone may be necessary. In conclusion an artificially filtered surface water will never compare with a natural underground water supply, even if the latter should have to be submitted to a subsequent sterilization.

(*Mr. Thomson.*) There is frequent reference made in the evidence to Mr. Karlson's Notes. Are they available and are they to be put in evidence?

(*The Acting Chairman.*) I think all the information in the Notes is contained in the evidence, and a great deal more.

(*Mr. Thomson.*) This, I take it, is a recapitulation or extracts from the Notes.

(*The Acting Chairman.*) Yes, practically. The Notes are almost entirely of a technical nature.

2177. (*The Acting Chairman.*) What would the cost be for a water supply from the Vaal?—My calculation on this subject showed a sum of £1,320,000. This was for 22,000,000 gallons. The filters were supposed to be only for industrial water and put down at £80,000 only, instead of £180,000 necessary for a drinking water supply. Neither was any dam in the Vaal provided, and as I stated in answer to a previous question I do not believe the Vaal Scheme possible without a dam. For 22,000,000 gallons the price could safely be put down at £1,800,000. The price for 22,000,000 gallons was calculated at 6d. per 1000 gallons in my estimate, but that was in calculating 10 per cent. interest and sinking fund. My project made in 1899 was based on a commercial undertaking. However, the Rand cannot be supposed to have an indefinite life; consequently interest must be taken at a high rate. With the same interest and the supplementary expenditure of £500,000, the cost would then be 7d. per 1000 gallons. This of course does not include distribution in Johannesburg, or in the other Rand Townships, but only delivery to a comparatively small number of mines and townships, so to say "at the door." For 5,000,000 gallons distributed in Johannesburg the supplementary expenses ought not to exceed 7d. per 1000 gallons, or 8d. if the water is sterilized by ozone.

2178. Could the expenses of your project be decreased, and to what extent?—Yes, my calculation was meant to be large. A reduction can, however, be made. First the friction in the pipes was calculated according to Darcy's formulae for new pipes. This gives for the large pipes an exaggerated friction, and the calculation should be made with the formulae of Levy for moderately

* Not printed.

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dirty pipes. Instead of a loss of 45 metres by friction we would then only have 20 metres, and instead of a total height of 370 metres we would only have 345 metres or 1132 feet. 1·333 kilogramme of coal or 4·4 lbs., was supposed to vaporise the 8 kilogrammes or 26 lbs. of steam calculated to be necessary for one horse-power per hour. In this way the pumping was included in the project at £36,000. In my Note* on the expenses of pumping I have shown that with the new combined water steam and sulphurous acid engine the steam consumption per indicated horse-power per hour has, for a relatively small engine, already been brought down to 9·5 lbs. per indicated horse-power, and for a large engine it is probable that it will not be more than 7 lbs. per indicated, or 9 lbs. per effective horse-power, or less than half of my calculation.

2179. What is your opinion on the advisability of a water supply from several sources?—My opinion is that this could only be advisable if one supply was insufficient and could not, with reasonable cost, be increased. It is evident that we must in this case, first of all, consider the expense, and it is well-known that for a large supply the water must be concentrated in one pipe. Several pumping stations and several pipe lines require more personnel for machinery and supervision. Several supplies mean more expropriation and legal difficulties arise, and the cost will be considerably increased without any benefit. I do not think that anyone will further consider any reasons of a strategic nature, and even if so, one supply is easier to protect than four or five.

2180. What is your opinion of the permanency of the actual underground supply in the Klip River Valley?—The permanency of such a scheme is certain for a limited supply, but not for a supply such as 30,000,000 gallons, which is required. The comparative invariableness of the water level in the Zuurbekom wells cannot give any conclusion in favour of such a permanency of supply, because the pumping there has often been very small and not sufficiently long. In my Note† on rainfall, evaporation, etc., I have given an example how in Liege from 1868 they have been obliged to increase the gallery by the constant decrease of the water. It is therefore certain to my mind that without any artificial increase of the quantity of water going beneath the surface of the earth, the underground water-supply will sooner or later fail, and when it fails through the drying up of the formation it will take years to artificially saturate the ground again.

2181. What is the rainfall and what is the quantity of water remaining underground?—The rainfall in Pretoria has varied in ten years from 39½ inches to 21 inches or from 994·5 millimetres to 530·4 millimetres, but large rainfalls do not count, because we have examples of 12 per cent. of the whole year's rainfall within a few hours, and this water goes direct to the sea. We have also the disadvantage of all the rain coming in the hot summer, when the evaporation and absorption by the vegetation is enormous. We have no forest here which could retain the water. However, in Europe, where they have all the advantages, some authors do not allow, for a highly absorbing ground, an infiltration of more than 20 per cent. In this proportion the infiltration would not be more here than 5 or 10 per cent., and for an area of 740 square kilometres of the dolomite formation of the Klip River valley, taken between the Black Reef and the Vaal, the whole yearly infiltration would correspond to a daily supply of only from 14,000,000 to 28,000,000 gallons instead of the 30,000,000 required, and the whole cannot of course be collected, existing streams must be respected, &c. (See my Supplementary Note* on Rainfall.)

2182. Is the construction of large weirs for storage of water possible on the dykes crossing the valleys on the dolomite formation?—This would only be possible if it were certain that the dykes crossed the whole formation. The dolomite passes under the slate formation, and lies so flat that the water will find its way to the river just the same, and the retaining capacity of such a dam would be very uncertain.

2183. Is it possible to increase the underground supply?—Yes; by the establishment of artificial lakes behind a large number of small cheaply built dams. In order to increase the absorption power of the ground, wells should be bored in these lakes to a certain depth in the dolomite formation, and blasted out at the bottom. If these dams are situated at a high level and the wells or gallery of collection very deep, there will be no difficulty to collect in these dams, and absorb by them, half of the rainfall which otherwise would go to the sea. By the long distance between the absorption dams and the collection wells the supply will be made, if not absolutely of constant capacity, then at least very nearly so. A total rainfall of 10 inches collected on 900 square kilometres would give in all 50,000 million gallons, or per day 140 million gallons, of which we could be quite certain to collect lower down the necessary 30 million gallons in addition to the actual capacity of the Klip River.

2183*a*. When did you first advise about the absorption dams?—In 1898 or 1899.

2184. Are any absorption dams used elsewhere?—Absorption wells have been used in Provence and absorption dams without wells are used in the north-east of the Cape Colony with very great success. Any intelligent farmer will say that he does not build dams for the storage of water but for increasing a lower spring. Individual farmers can, however, hardly build such dams if

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their farms are not sufficiently extended along the river otherwise the next man will profit by his work. I hear that Mr. Willcocks has recommended the absorption dams as the means of irrigation for a large part of South Africa, and that he speaks of new perennial streams of hitherto unknown magnitude which would thereby arise. If such is the case it is difficult to understand why he did not recommend the absorption dams for the Rand where they will find the greatest employment, not only in South Africa, but in the whole world. Thiem in Germany has recommended artificial underground filtration for several towns in Germany as considerably superior to any ordinary sand filter filtration, and my friend G. Rickert in Sweden has established such artificial underground filtration for several towns. In an admirable little book which I have just received, he describes this underground filtration for several proposed projects. This is, however, a filtration through sand or gravel formation and from a perennial spring. The filtration through a dolomite limestone may not be so perfect and here the principal object is to form a perennial stream.

2185. Is there no danger of water so stored being lost?—There is no more reason for this than the loss of the actual underground supply. If the ground is now soaked by it or saturated, there is no reason why we could not continue to soak it artificially. I have expressly also recommended the Klip River valley for this where the Black Reef is just at a sufficient depth and forming an enclosed basin.

2186. Is it possible to construct a permanent dam, south of the Klip River on the shale formation, and what would the storage capacity of this dam be?—South of the Klip River the water from the farms Doornkuil, Hartebeestfontein and Sijferfontein runs north to the Klip River through a poort in the range south of the Klip River. I have only seen this place once and cannot judge without further studies if a dam for a permanent lake is possible here. The drainage area is 93 square kilometres. If a dam of a height of 100 feet is made the useful quantity of water in this dam would be 3,840 million gallons, sufficient to give for 365 days 10½ million gallons per day. This is if we assume that 10 inches out of 25 inches could be collected. The new railway passes through this valley, but as far as I have been able to ascertain only through the upper part. If a permanent lake is not possible at this place it is, however, likely that the slate formation is not at a very considerable depth, and that it could easily be gone through. A very large absorption dam could then be established in this valley and the water would pass under the slate and join the wells along the Klip River.

2187. Can the power necessary for pumping the water from the different wells in the Klip River valley to Johannesburg be concentrated at one or two points?—The power which is necessary for the pumping of the water from the wells up to the Klip River Station should be given from a central electric station at Vereeniging. There the coal can be obtained at the pit's mouth and even the special waste be utilised. There is no difficulty to transport this power for a distance of 22 miles. For the part from Klip River Station to Johannesburg a heavy rise has to be faced and comparative calculation will show that this could be done in three or four lifts. It will then also have to be ascertained whether the power to these stations should be given from another central electric station, or if the pumping should take place direct from the steam engines. This entirely depends on the coal transport and only a definite project can decide this matter.

2188. Would it be necessary to build a general gallery from Klip River Station to Vereeniging or would the wells with a limited gallery be sufficient?—My project was to make the wells first at a distance of one mile from one another and to build out from these wells a short gallery. If this was not sufficient the 22 wells should be joined by a general gallery on the whole length. The work could proceed in every second well at the same time and the electric power be used for pumping out the working galleries. The cost of construction of the gallery would be £300,000. For a supply of 30,000,000 gallons to the Rand I consider the general gallery necessary. (See further on this subject, supplementary Note* on rainfall, etc.).

2189. What would be the quantity of water which might be expected from such an underground supply?—The maximum quantity which could be obtained, if 10 inches rainfall out of 25 inches could be collected in the dams, is 50,000 million gallons or 140 million gallons per day. A coefficient of security of one-fifth will give a daily quantity of 28,000,000 gallons.

2190. Are not the dykes a great objection to such supply?—Yes; I have pointed out that my project could only be undertaken after careful geological, hydrological and hydrographical studies. If dykes of any extension exist they can, however, easily be broken through in a few places, and the stream will pass through uninterrupted.

2191. What is the relative purity of the water from the dolomite formation, and can you indicate any means for its further purification?—On this question I can only judge from the analysis of the Pretoria water, and in my Note† on Composition of Water, I have given these analyses showing an exceptional purity from organic matter in dissolution and only traces of albuminoid ammonia. The number of aerobic germs per cubic centimetre is 70 to 100. From the latter figure it is seen that no perfectly sterilised water is obtained from this formation. Pretoria is exceptionally well situated. The water in these

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springs is drawn most likely from the formation south-east of Pretoria or north-east of the Rand. It reaches the fountains under a range of hills. If water from the dolomite formation was drawn instead from a vaucluslan spring such as Wonderfontein, it is very likely that the purity would by no means be so perfect and would besides be very variable. Therefore analyses in winter time would be very misleading. Only a very great length of flow in the fissures of the dolomite will purify the water. If the water is not sufficiently pure from albuminoid ammonia and microbes there is no difficulty in purifying it further by ozone.

2192. What is the mineral composition of the water from the dolomite?—In my Note* on the Composition of Water I have also given the analysis of the solid residue in milligrams per litre. (For grains per gallon the figures must be divided by 14·26.) Total solid residue 188 milligrams, of this:—

Silica	13·8	milligr.
Oxide of Iron and Alumina	0·4	„
Lime	52·2	„
Magnesia	38·4	„

This is, except for the silica, very much below the admissible proportions. (See same Note). Consequently the dolomite water must be considered as exceptionally soft for a limestone water. It also proves that the dissolution of the rock by the water is very much slower than in an ordinary limestone formation and the filtration or purification of the water must be more complete.

2193. How would the purity of the water be affected by the absorption dams?—It is certain that a large part of the purification of the water takes place in the first four or five feet of soil which the water has to go through. If there were no absorption wells the water would have to go through the bottom of the lakes and very little difference in the purification would be found. This, however, on the point of "Quantity" would not be sufficient, and the water must be absorbed through wells. These will, however, be provided with filters and with the great length which the water has to pass in the formation, this would probably be sufficient. (See further Note† on this point, my Supplementary Note on Rainfall, etc.) A further purification of the drinking water supply by ozone is besides quite possible.

2194. What would be the total cost of a supply from the underground stream of the Klip River as projected by you?—My estimate for 22 million gallons daily was £1,450,000. This does not include a general gallery for which the expense would mean a supplementary sum of £250,000 or £300,000. As in the Vaal Scheme, this project does not include distribution of the water in the townships.

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2195. What would be the cost per 1,000 gallons of water from the Klip River distributed "at the door" of the mines and the different townships?—For 22,000,000 gallons the price per 1,000 gallons was calculated at 7d. With the general gallery the price would be 8d. per 1,000 gallons, calculating interest and sinking fund at ten per cent. The reduction in the pumping expenses may, however, reduce this price a little.

2196. What is the present capacity of Wonderfontein?—The information on this subject varies considerably and goes from 20 to 30 millions or more per day. The uncertainty of the gaugings may to a certain degree depend on the application of a wrong formula, and in my Note* on Gaugings of Streams I have shown that this can account for a variation of 23 to 28 per cent. But there is no doubt that the discharge of the springs will vary considerably in different seasons, because the principal sources of these springs are undoubtedly the pans and they are only at a distance of eight miles.

2197. Do any springs come out higher up in the Wonderfontein loop near the Blaauwbank?—Yes, but these springs do not seem to be perennial.

2198. Can the present capacity of the Blaauwbank springs be increased?—Yes, in the same way as the Klip River springs by absorption dams. The basin is, however, not so advantageous as the Klip River.

2199. Is there any possibility of increasing the capacity of the great Wonderfontein?—Yes, I believe so, but I have only been able to collect information from land surveyors on this point. The pan or depression seems to be three miles wide. If it is only thirty feet deep the volume would be at least 12,000 million gallons. A small spruit comes from the farms Witfontein and Doornfontein on granite formation. The drainage area of this spruit is 25 square miles or 64 square kilometres. This spruit can most probably, without any great cost, be brought into the pan. This water will be absorbed there and follow the dykes to Wonderfontein springs. In this way a supplementary quantity of 6,000 million gallons could be given yearly to Wonderfontein, but it is not likely that this will be an absolutely uniform flow. (Six thousand million gallons equals 17,000,000 per day.) It is very likely that the flow along the dyke is comparatively rapid and that here an underground stream in a defined channel exists. This channel can, however, be blocked up and the stream made more uniform. In any case I consider that by the absorption dams above the Blaauwbank, and by this leading of water to the pan, a supplementary quantity of at least 6,000,000 gallons daily could be obtained.

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2200. Even if the increase is possible it will not be sufficiently permanent to supply the whole Rand from this source without using a large part of the existing discharge of Wonderfontein?—No, I do not think so.

2201. Will it be possible with this increase to take from Wonderfontein to Johannesburg alone a limited supply without appreciably affecting the actual flow?—Yes, I think that 6,000,000 gallons could safely be reckoned upon and this would be sufficient for Johannesburg.

2202. Do you consider that an underground connection between Wonderfontein and the Mooi River really exists?—Yes; there is no doubt on this subject. The Black Reef is uninterrupted to the west and the flow must go down to the Mooi River Eye which is 162 feet below the caves where Wonderfontein disappears. The uncertainty of the question is whether the flow is so rapid that it cannot any longer be called filtration or percolation, because in such a case the 19 kilometres (12 miles) connection must be considered as a natural stream, and falls under the present legislation for surface rivers in which case not a drop can be taken from Wonderfontein for another valley.

2203. What is the present legislation in this country on springs, running streams and underground water?—The use of the water in a public stream is regulated by Law No. 11 of 1894, which declares all streams to be "public streams" even if they are temporarily dried up. By other laws the ground of the stream is however the riparian owner's property. According to Law No. 11, the riparian owner can lead the water by furrow from the river; he can make a dam in the river even if the opposite side is not his property, but it is not specified if he can pump the water from the river to a higher level of his property for irrigation, but this may be included in the words "by furrow or otherwise." If his farm is on two water sheds he cannot in any case pump it to the other water shed. The only real restriction on the use of the water is that he must lead the surplus back to the river at the limit of his farm and that he may not use the water outside the limit of the riparian farm. According to Law No. 11, the upper owner owes damages to the lower owner:—

1. If he takes out more than half of the water if he is owner of only one river-bank.
2. If he makes an unreasonable use of the water.
3. If his dam or other work breaks.
4. If he has not fulfilled the regulation of the law for the keeping furrows and dams in a good state of repair.

This means that according to this Law no water can be taken from the river to other than riparian farms, and to these only, when the upper man has taken what he requires which can be the whole stream if he is the owner of the two river banks. Law No. 11, makes an exception for concessions granted before 1894, but it does not absolve the concessionaire from damages to upper or lower riparian owners. According to this law the question would be very simple, that is, in nine cases out of ten it gives the whole flow to the first man. But the question is singularly complicated by registered water rights, prescription rights, old laws, etc., but all this does not get over the fact that the lower riparian owners generally do not get anything at all. (On this subject see the case of Meyers and others *v.* the Johannnsburg Waterworks Company). The registered water rights have never fixed any quantity of water joined to the water right, consequently such rights are of a very problematic value. As regards the underground water and its interception before it appears at the surface as a spring, the owner of the farm is perfectly at liberty to consider this water as his property and do with it what he likes on condition that the communication with the spring is proved to be only by filtration and percolation. In my Note* on Ownership of Springs and Underground Water, I have cited two leading English cases on this subject. The two laws on surface and underground water are so entirely conflicting that at least for smaller rivers the law on the underground water absolutely nullifies the law on the surface water.

2204. Can you give us some instances of laws in other countries on underground water, springs, public streams and navigable rivers?—In France the owner of the ground where the spring rises can use this water in the limits and for the requirements of his heritage. He cannot use the same to the prejudice of a lower riparian owner who has constructed or completed permanent works for thirty years past on the ground where the spring rises. Towns or hamlets can by the declaration of public utility expropriate springs and bring the water to another valley by indemnifying the commoners to the water. The Administration does not allow any town to intercept a spring, and in that manner to escape the indemnity to the commoners. Special protection law exists for the thermal springs and, sooner or later, this law will be extended to all natural or artificial springs used for a public water supply. My Note† on Ownership of Springs and Underground Water contains further information on this subject. The law above mentioned in France only concerns non-floatable or unnavigable streams. The soil in these streams belongs to the riparian owners, but they cannot, without the consent of the Administration, erect any dam or permanent work in the river. When a river is so large that it can be considered navigable, or only

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floatable, the stream with the river banks to a certain width is national property, and the owners along the river are only allowed to use the water in accordance with the regulations issued by the Administration. After the report of Mr. Willcocks it would be interesting to know the different laws and regulations in Italy where the legislation of restrictions on ownership of water has up to the present been pushed the furthest, and Baron de Morpurgo, Italian Consul, has with great kindness given me the following information:—It must be said that except for the valley of the Po, very little irrigation was proceeding when this reform was made, which naturally facilitated the matter. Owing to these new regulations, and the security they have given, irrigation for agriculture has now assumed extensive development. By Law of 10th August, 1872, all rivers, brooks, and streams which give rise to a river were declared the property of the State and called public water. All persons who had rights to the water declared public, must apply to the Administration for confirmation of this right by placing themselves in the same condition as the new concessionaires for payment of the established tax. The Administration can in case of public utility refuse a concession by paying an indemnity or not, according to the nature of the pre-existing rights. The annual tax to be paid to the Government is proportionate to the quantity of water used and the rate is fixed differently according to the purpose for which the water is used. The Concession is given gratuitously to Municipalities or Benevolent Societies for distribution of potable water. For boring or digging a well on a property the owner must have the authority of the Government, and this well must not make any alterations to the hydraulic *régime* of neighbouring public or private water, nor damage to the neighbouring ground. The right is also limited to communication with other streams or wells by percolation or filtration, and is also restricted by sanitary regulations. It is difficult to decide on the right of selling water so obtained to Municipalities or others, but Article 544 of the Code Civil of the Kingdom of Italy, in force since the 1st January, 1866, enacts that in case of controversy the parties shall address themselves to the judicial authority who shall try to conciliate the interests of agriculture and industry with due regard to propriety, however, so as always to observe the general and local disposition concerning the use of water. The rivers are divided into navigable and un-navigable streams. For the derivation of the lakes and navigable streams the concession for derivation of the water must be given by decree. For the small rivers the authority can be given by the Prefect of the Province. The use of the water can be made according to the rotation law in existence but the commoner can also have the right, under certain conditions, to a certain fraction of a stream continually.

2205. Is a change in the present legislation on the water desirable, advisable, and practicable?—That a change is desirable we are all agreed upon. It is advisable because it must be done, and there are no insuperable reasons why it should not be practicable. At the amalgamation of the Italian States the laws on the subject were completely changed, and the law in France on springs is only since April, 1898. Formerly in France the owner of the ground was merely an exclusive owner to the spring. The inadequacy of the law is apparent in a large number of cases. In a small river the first owner can take the whole stream for agricultural purposes, even if a lower owner has used this water for years, and even if the lower owner has obtained prescription right he is not protected. In a large river where there is more water than is needed only a small triangle of ground along the river can be cultivated, because the water must be brought back to the stream at the limit of the farm, and thereby all combined irrigation is prohibited. Some farms have been so intelligently laid out that the limit is at a hundred yards from the river, and their water-right is then lost. Towns using water from the river to which they have water-right must return the dirty water to the river in the limits of the farm they are situated upon. When the ground between the town and the farm limit is not sufficiently large for a sewage farm or purification work, they are altogether in the hands of the lower owner and when the ground below is sold as building ground on speculation it is simply impossible for the towns to undertake sanitation work, because there is no means of getting the sewage over this extra township to a sufficiently cheap ground where it can be economically purified. The most dangerous of laws is the landowner's indisputable right to all water beneath the surface and the great facility with which a natural spring can be intercepted. I may offend the legal profession but this is simply monstrous. The industry may profit by this law in the beginning, but no one can prevent other people from doing to the industry what the industry has done to them, and we shall have a repetition of the underground fight which was so nicely proceeding with the thermal springs in France before the present law of protection was proclaimed. For the surface water the absurdity of the law is to have the same legislation for small and large rivers. Now, large rivers such as the Vaal—the farm limit is however here the river bank and not the middle of the river—Olifant, Crocodile, Limpopo, and in the Low Country, the large rivers, Komati, Crocodile, Sabie, Sand River, Umhlazie, Blijde, Olifant, Melati, Selati, Great and Small Letaba, Letsiteli, and Pafuri come under this law where the ground has been divided and the farms distributed. Enormous water power exists in these streams in the Drakensberg, of which most is, fortunately, still on Government ground, but if the division goes on

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the farm owner will get the water power and a fortune for nothing. I think I have made it clear that a radical change is necessary and that private interest, originally given by erroneous or incomplete legislation, and which interests have not been utilised till the present, must be taken over by the State in the common interest. I do not agree with Mr. Willcocks that the fault of this legislation lies in the Dutchmen and Englishmen who, coming from a foggy country and afraid of the water, made laws in this sunny part of the world where water, the life of the country, is scarce. The text of the laws is drawn from the Roman Laws which was the cause of the whole mischief. The new laws necessary are: Expropriation laws; laws of Declaration of Public Utility; laws declaring all large streams where all the water is not actually used for irrigation, as navigable or floatable, and thereby the property of the State; a new law on irrigation from the other streams, of which the riparian owners may remain owners of the ground, allowing combined irrigation by a rotation law; a law forbidding all permanent works in such rivers without the consent of the Administration: a law declaring all underground water the property of the State; it may run in defined channels or proceed by filtration or percolation. This would not hinder a man from making wells on his property, but he must obtain authority to do so. Such regulations must of course be issued so that the Administration does not make use of this discretionary power to the ruination of existing water supplies. Special conventions must be made with the neighbouring Colonies for the boundary rivers such as the Vaal and the Limpopo.

2206. If the proposed increase of Wonderfontein is not sufficient for the whole Rand without taking the whole or part of the actual discharge of the springs, are there any means of giving compensation to the lower riparian owners besides expropriation? (This question is of course subject to the proving of the existing communication between Wonderfontein and the Eye of the Mooi River.)—Yes; absorption dams can be built on the ground of twelve miles extension, where the stream is below the surface. Small works can be made in this underground stream, which is not very deep, so as to reduce the velocity of the flow. The Eye of the Mooi River on the Turffontein should be blocked up, and only a small opening left for a determined flow. At Frederikstad a dam can be built on the slate formation, and an artificial permanent lake formed which would give the same flow for the eight or nine months of dry season as the present Wonderfontein, less the quantity obtained by the absorption dams between Wonderfontein and the Eye of the Mooi River. My Note* on the Wonderfontein Scheme gives fuller details of this subject.

* See Appendix H. 5.

2207. What would the cost of these compensation works be?—I have estimated it at £850,000 for the large masonry dam and for the absorption dam. But the exact figures can only be arrived at by a complete survey. The large dam can also possibly be made partly of earth.

2208. Who are the riparian owners, and who would be affected by a decrease of Wonderfontein?—In the meaning of Actual Legal Rights Wonderfontein, and all the farms from Turffontein to the Vaal, and at least the Transvaal side of the Vaal to the limit of the country. These farms are—Turffontein, Muiskraal, Kiel, du Toit Spruit, Gerhard Minnebron with the village of Frederikstad, Katdoornbosch, Buffelsvlei, Witkopje, Naauwpoort, Kolonies Plaats 1, 2 and 3, Witstinkhoutboom, Witrand, Vijfhoek, Elaandsheuvel, Townlands of Potchefstroom and Potchefstroom, Wilgeboom, Haaskraal 101, Haaskraal 173, Uitval, Taaiboschbult, Uitval 254, Hooge Kraal, Kromdraai and sixty farms along the Vaal. Besides if the under ground part of the Wonderfontein loop is a defined channel, the three farms Blaaubank, Welverdiend, and Stinkhoutboom have also a legal right. But in the meaning of actual damage for depriving these farms of water at present used, only those from Witrand to the Vaal will be affected, because at Witrand the Mooi River never contains less than what the Wonderfontein is giving. The farms from Turffontein to Frederikstad situated on the Wonderfontein loop will be served by water which will naturally be collected in the whole dolomite formation between Wonderfontein and Turffontein.

2209. Can you tell us anything about the underground water level from Mooi River to Wonderfontein and Zuurbekom and the Klip River?—In adopting the most probable height above the sea level of Johannesburg Park Station, which is 5704 feet 10 inches,

The Eye of the Mooi River on Turffontein is	4690	feet.
Wonderfontein Lake	4870	„
Little Pool on Upper Wonderfontein	4923	„
Standing water level on the Zuurbekom Wells	5115	„
Suction Water level in Zuurbekom Wells	5075	„
Eye of Klip River..	5107	„
Water level in Melvill's shaft on Olifantsvlei	4972	„
Klip River at Station	4959	„

These are approximate levels, but show that Zuurbekom is really the dividing line of the underground water level between the valley of Mooi River and Klip River. They also show that the gradient immediately on each side of the Zuurbekom is 0·00195 and 0·00163, and that the general gradients between Wonderfontein, Zuurbekom, and Klip River Station are 0·00197 and 0·00226. From the Klip River Station towards Meyerton the Klip River has a smaller fall, which makes it possible to build an underground gallery almost

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horizontal. After Meyerton the fall is greater, and it may be necessary to make a cross gallery in the valley to close the outlet to the Vaal.

2210. How would such a steep gradient of the underground water-level affect the Zuurbekom water supply?—It is evident that only with a great depth of the wells, a sufficient area can be interested. With a depth of 40 feet under the natural water level or 80 feet under the surface only four miles can be included. In taking the water from such a small area and on the "top," the chance is also that a large part of the water absorbed by the ground takes the natural course to the streams, and every probability exists that at the end of the dry season the capacity of the wells will considerably diminish. Only an experience of considerably long pumping can decide this subject, but such taking of water from the top of the water-shed is decidedly uncertain. (See further my Note* on the level of the water on the dolomite formation.)

2211. Do you consider it advisable to take a water supply from the north-west of the Rand?—A part of the water supply to the Wonderfontein is undoubtedly derived from the high water shed and coming down through the interruption of the Black Reef series, so that between the water shed and Hennops River the Rietspruit Valley has a length of 50 kilometres and about 9 kilometres width of dolomite. This is only 450 square kilometres of dolomite formation. In this spruit absorption dams can be established, but the absorbed water may run down under the slate formation instead of towards Hennops River, so that the scheme on this side is very much less certain. A dam in the Crocodile is built just at the edge of the dolomite, and notwithstanding the great quantity of water coming down the Crocodile it is hardly possible to get the water up to the edge of the dam. This may be partly through leakage through the dam, but it is more likely that the great supplementary pressure brings the water down in the dolomite. A high dam through the Poort in the Magaliesbergen range would have been more certain. But this is 38 miles or 61 kilometres from Johannesburg, and very low under the Rand. A magnificent lake could, however, be formed there.

2212. Do you think it advisable to take the water from the north-east of the Rand?—A large stream of water has been found on the farm Olifantsfontein, north-east of Boksburg, but this is the basin which undoubtedly is supplying Pretoria, and I am too strongly of opinion that existing supplies must be respected to recommend any project on this side. The supply to Pretoria can also be increased by absorption dams in the Six Mile Spruit.

2213. What quantity of water would be necessary for the Rand and the Rand Townships?—The Secretary of the Chamber of Mines announced the other day that 20,000,000 gallons would within five years be required for the Mines. I understand that this is only for the milling and cyanide process. But all the townships from Krugersdorp to Springs must also be supplied. For this purpose we must allow five million gallons at least.

2214. What will be the quantity required for Johannesburg?—If the calculation is based on 100,000 inhabitants including native servants the following would be required:—

1.	For household purposes and water closets ...	5,500,000
2.	For private gardens	1,700,000
3.	Public service including sewers	2,675,000
4.	Industry	500,000
5.	Leakage	825,000
	Total	11,200,000 gals.

The sewers to be flushed are calculated to be of a length of at least 250 kilometres, or 157 miles. My Note* on Quantities of Water in a Modern City gives all the details and clearly shows that no reduction can be made in these figures.

2215. Is it necessary to bring all this water from below, and if not, how should the remaining portion be supplied?—No; my opinion is that it is not necessary to bring the whole supply from below and that it would even be a great mistake to try to do so. The quantity required for the Rand is quite large enough without it and no waste must take place. My Note* on Quantities of Water required in a Modern City shows that half of the required daily consumption of water can be used over again and distributed through a second pipe-net.

2216. Do you think it necessary to establish a gravitation water-carriage sewer in Johannesburg?—Yes. All domestic water, that is kitchen and bath water, must be taken to the sanitary sewer. This water cannot be taken to a pneumatic sewer, at least not to the Liernur sewer, and if it was carried to the rain water sewer this second sewer must also be disposed so that it can carry the water to a place of filtration; during rain storms it will be thrown out in the street. Besides the faecal matter, if not mixed with a sufficient quantity of water, cannot be treated on bacteria beds or on a sewerage farm. Two such sewers with two house connections would be altogether too expensive, and besides dangerous, because as much urine will go into the rain water sewer as into the pneumatic sewer.

2217. What is the total quantity of water which is needed as a supplement for a gravitation water carriage system instead of a pneumatic system?—500,000 to 1,000,000 gallons, or 4½ per cent. to 9 per cent.

* See Appendix H. 9.

* Not printed.

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2218. Is there any danger of the water-carriage system causing infiltration to the subsoil?—If the joints are properly made there is no more danger on this point than with the pneumatic sewer, in fact rather less, because india-rubber joints in this country will not last for ever.

2219. Is the effluent from a sewage farm perfectly pure?—This depends on the nature and depth of the soil. Sandy soil is the best for purification but is not worth anything for agriculture. A mixture of sand and clay is the best. With such ground and the irrigation properly managed the effluent can, if necessary, be discharged into the river without any damage, provided no cyanide has originally been let into the sewage. On the large Continental sewage farms the effluent water is even used for drinking purposes.

2220. What does this effluent contain?—The bacterial purification is such that from 17,000,000 germs per cubic centimetres the number is reduced to from 500 to 3000. The purest dolomite water contains 100. The organic matter in dissolution and the ammoniacal nitrogen is reduced to traces, but the nitric nitrogen in the form of nitrates is considerably increased. This can only be avoided if the sewage farm is so large that all the nitrogen is absorbed by the vegetation. The solid residue after evaporation at 110 Centigrade is 300 milligrams per litre or less than is contained in many hard potable waters.

2221. Can the remaining nitrates be considered harmful to human beings?—No; sanitarians condemn water containing a large quantity of nitrates only because the nitrate clearly shows the origin of the water, and it is, of course, not desirable that such water should be used for drinking purposes.

2222. What standard of purity has the effluent from the septic tanks and bacteria beds?—In the septic tank alone the suspended solids are reduced by 71 per cent. The albuminoid ammonia by 81 per cent., and the oxygen absorption 50 per cent. When the water is used for subsequent irrigation one contact bed is sufficient, but if the water is let out in a stream two or three contact beds will be required. From the third contact bed the water is purer than the effluent from a sewage farm, except that the proportion of nitrates contained in the water is slightly greater, 5 per cent. about.

2223. What is the best plan to prevent the greasy deposits in the septic tanks?—A grease box must be fixed under every kitchen sink in the whole town. Severe regulations must be issued that the grease must be skimmed off and the box regularly cleaned. The Sanitary Inspector at each visit must ascertain that this has been done. I have noticed that with a lot of worry it is not impossible to get the public to observe the necessary sanitary rules.

2224. Can the water from the bacteria beds be used again in a second pipenet for distribution as a second class water?—No; the number of bacteria is still too great even from the third contact bed, and the presence of a few pathogenous microbes must always be feared.

2225. How then could this purified sewage be distributed again as a second class water?—The water purified in the septic tanks and on the bacteria beds must first be treated with peroxyde of chlorine. This will completely sterilize the water and oxidise all the remaining traces of organic matter in dissolution.

2226. If this second water distribution is made, how much water will remain to be used on the sewage farm?—Based on a population of 100,000 inhabitants, the volume still remaining to be employed for irrigation of a sewage farm would be 1,400,000 gallons.

2227. For how many people could this sewage farm give vegetable food?—At the Parisian rate of 400 grammes, or 1 lb. per day, the number would be 110,000.

2228. What vegetable could be cultivated on this farm if the treatment is combined with bacteria beds?—All market vegetables such as potatoes, cabbage, carrots, salad, asparagus, etc., strawberries, melons, pumpkins, etc.

2229. Do you know of any other method of sterilization of potable water than by peroxyde of chlorine?—Yes; by treatment with ozone. This method which has been in experimental stage for several years has, however, now been practically rejected.

2230. What would be the cost of the septic tank and bacteria bed purification of water?—For 5,600,000 gallons to be redistributed the expense would be, including 7 per cent. interest and sinking fund, approximately £18,000 per year.

2231. What would be the supplement of cost for the further purification with peroxyde of chlorine?—For 5,600,000 gallons, 25,400 cubic metres per day, the cost of chemicals would be, per year, £250. I have no information on working cost and necessary buildings, but I do not suppose the whole yearly cost will exceed £1750—total, £2000.

2232. How does the cost of the distribution of this second class water compare with the cost of a direct distribution of water assuming that the supply below the Rand is unlimited?—In calculating the price of the water from below at only 5d. per 1000 gallons, the cost of 5,600,000 gallons of water daily will yearly amount to £42,583. If the town supply is made separately from the Rand Water supply the cost will undoubtedly be much greater.

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The supplementary cost of a second pipenet for 232 kilometres would be approximately £200,000, of which the interest and sinking fund at 7 per cent. is	£14,000
Of the cost of the purification of water we can include a sum of .. .. .. (which is large, because the water must always be cleaned.)	£5,000
Supplementary maintenance expenses	£4,500
Total,	£23,500

The yearly saving by the second pipenet will then be £19,000. If the population should increase above 100,000, the saving will be so much the greater.

2233. Supposing the domestic supply is taken direct from the dolomite formation, is it necessary to sterilize this water before distribution by the ozonisation method which has been described by you?—This can only be shown by repeated bacteriological analyses, but I firmly believe that it will in the end be impossible to give such a large supply a sufficient protection area without any farms or other townships included within this area.

2234. What would the cost of such supplementary purification by ozone be?—At one penny per 1000 gallons the expense would be for 5,600,000 gallons per day, £8,500 per year, but with Andreoli's New Ozone Producer the cost will be reduced to one half of this sum.

2235. If the water is distributed perfectly pure in the pipes, are there in the distribution itself any sources of pollution?—Yes. (1) If an intermittent supply is used for parts of town a suction from inside is produced when the water leaves. As leakings cannot be avoided the dirty water from outside leaks into the pipes. (2) When water is collected in tanks it gets polluted by the heat. In most cases the ball-cock dips into this polluted water and when the pressure is weak the water gets into the main. (3) Garden hose fixed to the taps are generally employed. These garden hose lie wet in the gardens and are soiled. When fixed on to a tap again a suction from the main is often produced, especially when another tap on the same service pipe is opened. Other causes may exist but these are the three principal ones.

2236. What can be done to avoid this pollution?—Avoid an intermittent supply entirely. Put the ball-cock high enough above the water. Totally prohibit the fixing of the hose on to the taps connected directly to the mains.

2237. By prohibiting the hose taps from being fixed on to the water mains, how are the gardens to be watered?—Small gardens can be watered by watering cans, but for a larger garden a special tank slowly filled at night will be required.

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2238. Is this method of fixing a special water tank for the larger gardens and to distribute water from there to the gardens particularly expensive as a first installation?—No, the expenses will not exceed £30 in any of the large gardens in Pretoria.

2239. Will this method be of any benefit to the water distribution itself?—Yes, an immense benefit. Sometimes 3,000 garden taps in Pretoria are open at the same time, requiring 720,000 gallons per hour, or nine times the normal capacity of the mains. The tanks will distribute this flow in the night hours, and in the day the mains will be used for the domestic supply. In this way the pressure can be kept up.

2240. You have communicated certain figures to the Town Engineer of Johannesburg regarding the consumption of water in Pretoria?—Yes.

2241. Are the figures 64 gallons per head from the pipes, and 80 gallons per head of population from the furrows for garden supply?—Yes.

2242. How do you account for these large figures?—The 64 gallons from the pipes include a small garden supply to the suburbs which are not provided with furrows, but the difference of supply in rainy weather is only 400,000 gallons, or 20 gallons per head. Of these a certain amount is accounted for by a smaller use of the bathroom in rainy and cold weather, and by the suppression of street watering. This means—that in basing the calculation on 20,000 inhabitants—the domestic and public supply is at least 44 gallons per head, native servants included. Pretoria contains a large Dutch population of the poorer class which generally has very little acquaintance with God Neptune. The water is not even supplied to these parts of town except by a public standpipe. There is at present no public wash-house, no abbattoirs, so that, deducting for the Government buildings and a small supply for industry, 40 gallons is well used for the houses. Of this I recognise a part is waste and must be restricted by meters, but on the other hand there are no grease boxes, and no flushing of private drains. If we had an almost entirely European population, water closets, grease boxes, flushing of private drains, and washing in the houses, it will be seen that the figure of 55 gallons for domestic supply given in my Note* on Quantities of Water in a Modern City, will be easily attained and only kept within this limit if a distribution on a general meter system is adopted, and with a more general use of the shower bath instead of the plain bath. Eighty gallons per head for garden supply is, of course, a pure waste, but this amount does not only run through the town as supposed. The use of the furrows is for twelve hours, and during this time 2,000,000 gallons at least passes through, of which four-fifths is used—that is, 80 gallons per head. But the waste occurs in water-

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ing gardens by furrows, which require a considerable amount of water. If the watering takes place from the taps, 0·4 gallons per square metre is used, and as I calculate six persons per half-erf, of which the half is garden, I have 250 gallons per house, or 42 gallons per head. This is only the half of the furrow, but means a considerably greater number of gardens.

2243. How do you explain the great amount of water used by Pretoria and American towns in comparison with English and Continental towns?—The large English towns include a large working population. This population has not yet been educated to the general hygienic rules. Bathrooms in the workmen's houses are still exceptions. The houses they live in are large barracks where the combined drainage from several householders require less water for the cleaning of the private drains. On the Continent, water-closets are still exceptions, bathrooms are unknown, even in the rich houses, and the population is still more concentrated. Besides there is hardly a town which does not contemplate a large increase of the supply. In America, I mean the United States, the social rules are so entirely different, that workmen live like any other educated men. There is a bath-room and hot water in almost every house and no one will dream of how this hot water increases the consumption. Johannesburg must be compared with an American town and not with a European town. The waste in the American towns, which is great, notwithstanding the steadily increasing number of water meters, must be taken into consideration, but we must have cleaner streets than in America, better maintained house drains, more gardens than in America, and no accumulation of the population in large barracks. An enormous amount of horses are kept in town and a small proportion of children is included in the population of Johannesburg. All this means water, and if the Director of the Water Supply in Paris, Mr. Huet, in 1878, already estimated that 90 gallons per head will be necessary in any larger town in France, how much more true will this be in this climate?

2244. How then is it that they manage in other South African towns with a smaller supply?—A larger number of natives are first of all very likely included. The rates are low for each house, but this is for a ridiculously small amount of water. What is over is generally paid for by meter at a very high price. The flushing of the house drains is so little attended to, that their drainage system is dangerous, and a public water supply does not exist. All washing is done in the rivers and in some instances an intermittent water supply, the most dangerous and the greatest water saving system in existence, is employed. This is quite sufficient to account for it.

2245. But in Johannesburg how can 900,000 gallons have been sufficient for 100,000 inhabitants?—It has never been proved that it has been so. It is not quite clear in the census how many of the population were natives on the Mines within Johannesburg, and it has been shown in previous evidence that large private supplies have existed. There has been no washing done with Waterworks water. The washing has been done with contaminated water, spreading typhoid all over the place. No private drains have existed and consequently no flushing has taken place. As the Waterworks Company has only just before the war given, so to say, water to drink, few houses were fitted with bathrooms or even with showers. The exorbitant price has of course kept the consumption down and when the water was consumed one had to pay again as much to have it carried away and to take all the trouble to bale this water out to the slop-cart. This last is surely a better means against any use of the water than even the water meter; the rate of 10s. per thousand gallons and the 6s. to have it carried away. I only wonder how it has been possible for the Waterworks Company to get the people to use so much.

2246. Then you do not consider the allowance of 20 gallons per head as proposed by Mr. Stewart sufficient, as long as no drainage system exists?—It is too much. For 100,000 inhabitants this means 2,000,000 gallons or 1000 slop-carts with 4000 mules to carry it away, and a nice expenditure of £360,000 per year. The people will rather go without a bath for a month than pay that sum. Garden watering with slop-water is all an illusion. I thought that I should get the people to do this, and I had to give it up.

2247. But if drainage for slop-water alone was constructed, and the pail system continued, could not the requirements be reduced?—This would be the greatest mistake in the world. This drainage will require exactly the same amount of water for flushing as the water-closet drain. The private drains without sufficient flushing must not exist. As soon as a covered drain exists all the slop-water without grease separation goes there. The grease is deposed in the drain and when all the urine and liquid fæcal matter is thrown in there, it is in this extremely favourable medium that typhoid and other diseases are bred. To keep the urine out of them is impossible. No sanitary regulations or Sanitary Inspector has ever been able to obtain this miracle, and even if this miracle is obtained the rotten vegetables or other stuff are quite as bad. No one of my men in Pretoria is allowed to break up these drains without smoking a pipe and in taking all possible precautions for previous ventilation. Still the work is so dangerous that I cannot get any more kafirs to do it. If, notwithstanding the danger, such slop-water drainage existed, this slop-water must go somewhere and it can surely not be allowed to go into the spruit. For irrigating a farm it is not worth anything except as water, and then the grease must not be

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in it. All this water must then be cleaned at a great expense and still we keep the pail system at, at least, 5s. per house per month or £50,000 per year. This goes a long way to pay for a supplement of water.

2248. Then your opinion is that there is no alternative between 10 gallons per head and no drainage, or 100 gallons per head and drainage with water closet system?—No, if the houses and the town be kept in conformity to sanitary rules there is no intermediate solution between the two figures; but as elsewhere explained the half of the supply can be used over again, so that 50 to 60 gallons per head will be sufficient. For a still larger population, this population must include a much larger number of natives, and the public service will not be any larger than I have provided. The proportion will then, for any population above 100,000, considerably decrease, instead of, as in Fanning's table, increase; but for my part I am not so absolutely confident in this enormous increase, which even the working of the low grade mines will not justify.

2249. What do you think about the future price of water?—If one million gallons per day is paid now, per year at 10s. per thousand gallons—1,000 × 10s. × 365 = £182,500—for 5,600,000 gallons, provided no mistake of drawing supplies from several sources is made, there will be 1s. 3d. per thousand gallons to pay—5,600 × 1s. 3d. × 365 = £127,800. The distribution of the second-class water will cost, with pumping, a maximum of £32,200. Total of £160,000. This sum of £160,000 represents, per head of population, 12s., or per house of six persons, £9: 12s. per year, or 16s. per month. This includes of course taxation for street watering and for the public water supply, and this can by no means be considered in this country as a very large amount. I have no idea how much is paid now for sanitary service and slop-cart, but if the slop-cart service was or could be properly carried out, £100,000 would not be sufficient for the present supply. The two services together represent then £150,000.

A double drainage scheme may cost	£1,600,000
(Including house connections —this for 230 kilometres.)	
At six per cent. this is per year	£96,000
Working expenses	£24,000
Total	£120,000

The sewage farm will not only pay for itself, but also the expenses for the cleaning and sterilization of the water to be re-employed. No increased taxation is then necessary and the town will have a double sewer net and can be able to undertake the repair of the roads, which is impracticable without a drainage of the rainwater. There is not then anything insuperable in these figures, but as explained the whole thing depends on the second pipe-net for redistribution of the water without which there is no possible solution of the problem within a reasonable price.

2250. Do you consider that meters are necessary, or that the use of meters is contrary to hygienic principles?—My figures are not large and the meter is absolutely necessary where there is a garden even of ten square yards. Even where there is an outside tap the meter is also necessary. For houses without gardens the meter is of no use where the house is inhabited by several tenants, in which case the landlord is responsible to the Corporation. Each tenant should then have a meter. Where wash-hand basins connected to the drain exist an enormous waste takes place. Water is also constantly used for cooling soda-water bottles, by letting the water run constantly over them. Native servants can also use a widely different quantity for washing in kitchens without any profit. I am, therefore, of opinion that a water distribution without meter is hardly possible. The rate must, however, be fixed according to the size and value of the house, and a sufficient quantity allowed, not necessarily in accordance with the price paid. What there is over must be paid for and at a high price if the meter is to be of any use, as this hygiene and saving of water is combined with profit.

2251. You do not consider that more than ten per cent. is absorbed by the dolomite formation for an underground supply?—No, I believe this is even a high average. The dolomite is not such a sponge as is generally believed. It is only the fissures which absorb the water, but great underground cavities undoubtedly exist. On the south of the Rand it is difficult to judge by the springs of this infiltration because part of it finds its way to the Vaal. But to the north of the Rand the springs on the limit of the slate formation are overflow springs. The formation under the slate is undoubtedly saturated and the water is kept back or up by the underlying formation, or thrown back by the pressure of the steam formed at a sufficient depth. This water is thrown up as thermal springs, but except at Warm Baths few such springs exist. The dolomite basin under the slate must therefore be considered as full, and the spring on the limit of the slate formation will give the amount of the yearly infiltration. If we make allowance for Wonderfontein, which through the pans has such a great flow, we shall find that the combined springs to the north will not represent more than ten per cent. of the whole rainfall in this area, and a part—but a small part—from the higher impermeable formation which is absorbed in the river beds passing over the dolomite. Mr. Willcocks, who seems to have had some very optimistic ideas on a lot of things, did not himself consider more than three inches, which is eleven per cent.

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2252. Supposing that all the water exceeding this amount of 10 per cent. of the rainfall was pumped from the dolomite, would this eventually exhaust the water accumulated in that formation?—Yes, most decidedly, but it would also at the same time dry up the perennial streams.

2253. Within what period?—This depends of course on how much more than the normal amount there is taken. No one can tell the size of the cavities below, and the size of the formation is not sufficiently known yet to be taken as a basis for any calculation on this subject.

2254. You have read the evidence of Mr. Stewart on the Steenkopjes scheme?—Yes.

2255. Have you any remarks to make thereon?—I have never been at Steenkopjes, so I can judge with difficulty, but I know well the Magalies River and the farms along this river. Mr. Stewart gives a gauging of the springs of 15,000,000 gallons per day. Mr. Willcocks, who has evidently practiced judging from sight, has given 9 to 10 cubic feet per second, 10 cubic feet, or 62·3 gallons. Per day this amounts to 86,400 plus 62·3 or 5,400,000 gallons. All the landmeters I know say it is hardly more than Apies River. It is difficult to know who is right in this matter. I have elsewhere pointed out that gaugings over weirs give an uncertain return of 20 per cent. if the right formula in each special case is not employed. But this does not account for the difference. Springs have as a rule here a very constant discharge, but there is no reason why there should not be an exception to the rule, and that we should here have a variable spring of a very dangerous nature for a water supply Even if it has the 15,000,000 gallons as a constant supply, this spring could not be taken for a single project. It can hardly be increased by absorption dams, to judge from the maps and information. The spruit coming from Hartebeestfontein flattens out on the farm Wolvekrans, and absorption dams of sufficient size could not be built. The distance across the formation is also only seven miles, or 11 kilometres. The water from the absorption dams might also as well go to Wonderfontein or to the Rietspruit instead of the Steenkopjes. If the 15,000,000 gallons of Mr. Stewart were all taken, this amount would have to be given to the river daily for nine or ten months, which means a storage of 4,500,000,000 gallons. According to the latest maps made in the Surveying Office in Pretoria, the ground seems to me rather steep for that; a dam of a reasonable height should be able to contain this amount, together with six or seven feet necessary for evaporation and infiltration. Considerable supplementary surveys and gaugings are then necessary before anything can be said on this project.

2256. You speak in your scheme about a dam in the Crocodile River at the poort in the Magaliesbergen. What would this dam hold?—This is a most magnificent site for a dam. Three rivers meet right at the poort, and the water can be dammed up in the three rivers. The farm, which the lake should cover, is certainly very valuable, but should not make the project impossible. The wall, even of a height of 45 metres, or 147 feet, should not at the top have a length of more than 100 metres, and even a horizontal arch could be employed for the dam. I had projected a large bridge of a single arch at this spot, so I know it well. I should think that such dam could contain 20,000,000,000 gallons, or per day a supply of nearly 60,000,000 gallons.

2257. How would distance affect the cost of supply?—For a small supply the long distance is prohibitive, but for a large supply the distance is not of great importance. The height to lift the water is very much more important, as more pump stations must be employed, or a greater thickness of plate adopted, and of course more coal used.

2258. Have you any experience how water from dolomite affects boilers?—Yes: I have been temporarily Acting Boiler Inspector, and I know this question well. The dolomite water is, of course, not as soft as rain water, but when the boiler is carefully handled there is no necessity for any water-softener whatever. The acid water from the mines is without comparison considerably worse. Besides, I do not understand the discussion on this matter, because the Vaal is the same water, and there is no reason that it should be softer because it flows in the river, except, of course, in rainy weather. In my Note* on "Composition of Water," it will be found that the Danube, for example, has at places a solid residue of 250 milligrammes per litre, instead of 188 milligrammes in the dolomite water.

2259. You have read Mr. Stewart's evidence on the Zuurbekom Water Supply. Have you any remarks to make thereon?—Yes: I think Mr. Stewart had better adhere to his original figure of 1,000,000 gallons. My Note† on the levels covers this subject. I am not certain that the "suction level" mentioned in Mr. O'Reilly's letter‡ is the actual suction level. If it is not, it is only so much more certain that they are pumping out existing underground basins. If the Consolidated Goldfields' project of pumping from Olifantsvlei is put in execution, they will of course have to lower also the suction level, and a glance at my sketch‖ will show that the water will on the upper side take a new lower level of equilibrium, and then where is Zuurbekom? It is difficult to believe that it should not affect it in the length of time. The supposed dykes on each side of Zuurbekom are not serious, because where would the Klip River come from?

* Not printed.

† See Appendix H. 9.

‡ Not printed.

‖ Not printed.

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2260. You have read Mr. Goch's evidence on Wonderfontein and the experiments made to prove the communication between Wonderfontein and the Eye of the Mooi River?—Yes. I am afraid that Mr. Van der Merwe went to sleep or that he did not wait long enough, but experiments such as these must be done by method. Mr. Goch must really be the only man who believes—if he does—that Wonderfontein disappears and goes to the centre of earth. It would be evaporated before that. Communication like this, of even greater length, is in existence in hundreds of places in the world. Wonderfontein is not so wonderful after all, because the pans are the principal source, and the Mooi River is the certain outlet. Is it possible to think that the quantities of the two springs have such a marvellous coincidence without communication between them? The Mooi River has increased to 35 or 40 million gallons, the increase corresponding to the water from the supplementary area of the formation of dolomite which the Wonderfontein loop crosses. There is no outlet for the Wonderfontein to the West, so where should it go if not to the Mooi River? Another thing is, if it is by filteration or percolation, it is certainly not one chance in a hundred that it is so. A stream of such magnitude could disappear on the sand, but in the dolomite certainly not, if there were no large fissures which could not allow any longer the expression, filtration and percolation, and it is on these two words, which are entirely conventional, that the project depends. It is not necessary that it should be by filtration, because the corks of Mr. Van der Merwe were stopped. If we put a grating or even a fine sieve in a channel this will also stop the corks, and no one—not even Mr. Goch—will say that there is no longer any defined channel. La Loue, the second spring in France was through its relative purity believed to be an absolutely original spring, and even Professors of the University of Besançon had tried for ten years to prove the communication with the Doubs by using fluoresceine. Then when "Pernod fils" was burned in Pontarlier it took only 24 hours for the whole stock of absinthe to run the 12 kilometres in direct line from Pontarlier to "La Loue," and to colour the water in the spring as green as any glass of absinthe in a café. It is then no wonder that Mr. Van der Merwe did not succeed. But it is puerile to believe that these people are going to sit still. The first thing they told me was that they were going to take the question up again, and I was astonished to hear that they knew perfectly, as well as myself, of the new method with levure of beer. There is then no use to hide these things, but to see first of all, before any expense is made, who is right, and there is not one chance in a hundred that the Potchefstroom people are in the wrong. *Re* the gaugings, I have elsewhere explained that it is almost certain that Wonderfontein is variable, and that gaugings must be taken for a long period. I am obliged to remark that it is more than neglect that all these necessary gaugings were not properly made by persons interested in this water supply—the former Government first of all—and it is a real pity that valuable time has been wasted. Even the Government, except President Kruger himself, must have had doubts about this communication, because if they firmly believed that there was no communication why did they reduce the quantity to be taken to a quarter or a fifth? Why should they leave the other three-quarters or four-fifths to run back to the centre of the earth to the profit of nobody?

The Commission adjourned for Luncheon.

ON RESUMING,

2261. (*The Acting Chairman to Mr. Karlson.*) You know Mr. Cousens' project for pumping from the Vaal?—Yes.

2262. Have you taken any gaugings there, and what do you think about the scheme?—Yes; in April and May, 1897, I gauged the Vaal at Standerton, together with Mr. Jorissen, Government Surveyor, and his assistant. I found there 17,000,000 gallons per day. I was told that this was not even the lowest level. The gaugings were very exactly made. As seen, this was only in the beginning of the dry season. I have a great experience of Transvaal rivers, and even in the low country a week after the rain they are again in a normal flow. The calculations must be based on the gauging during the dry season. When I first began to think about this water supply I heard all the enormous figures of the gaugings in the Vaal, so I was, of course, rather anxious to know where it all came from. I therefore multiplied the figures of 17,000,000 to 18,000,000 I had found at Standerton with the drainage area of the Vaal at Vereeniging, divided by the drainage area at Standerton. This proportion is $\frac{48,000}{8,680}$ and I arrived at 100 million gallons per day. This was so much below all the figures I had heard of that I kept it. But if the drainage area affects more or less the maximum discharge of the river, the minimum discharge has very little to do with it. No one of the rivers joining the Vaal below Standerton has the importance of the Vaal, so that even this figure of 100 million gallons per day at the Vereeniging low level must be grossly exaggerated. I will, however, admit 90 millions, or three times the quantity necessary for the Rand. Mr. Cousens proposes a dam 140 feet high—that is 42.7 metres. The Vaal itself is only 13 metres deep, so that the height of the dam on the high banks will be 30 metres. I do not know any place between Klip River and Vereeniging where such a dam should have less than 1,500 metres in length, if this is sufficient. I leave it to Mr. Cousens to calculate the price of this dam, which will not be under £2,000,000. The calcula-

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tion of the volume of the lake must be made above the level of 20 metres from the bottom of the stream. We cannot take less, because as the water runs out during the dry season, a head must be left to get any power at all. The lake will have a length of (if 2 metres is taken off for evaporation) $\frac{40{\cdot}7}{0{\cdot}0004} = 102$ kilometres. This brings us up above Standerton, and what a nice number of bridges there would have to be built There would be work for a bridge engineer alone for many years. The 20 metre level will reach $\frac{20}{0{\cdot}0004} = 50$ kilometres above the dam. The quantity retained will be 1,520,000,000 cubic metres (it will of course be narrower higher up) or per day for nine months dry season, 5,630,000 cubic metres, or per day 1,200 million gallons, and with the supply of the normal flow, 1,260 million gallons. The head on the turbine is 20 metres. The lift, including loss by friction, is 400 metres, and the quantity to pump, 30,000,000 gallons. It requires to pump this to 400 metres a number of horse-power = 20,000 x C.. 1,260 million gallons will develope 25,000xC. This rough calculation shows, then, a supplement of a quarter of what is necessary. But if the cost is estimated, with all the land to be bought, bridges to be built, &c., £2,500,000 is a small estimate. We have the cost of this pumping at only 5 per cent., £125,000. With coal and the newer machines it will cost £30,000 to £40,000. It is true that 1,200 million gallons remains for irrigation of the lower Vaal, but the fault of the Vaal is that it is so deep that the water cannot be utilised. A second dam must then be built for this purpose 30 kilometres below. Put in this way the scheme is not a Utopia, but is rather gigantic for this country, and would take ten years to build.

2263. You have seen Mr. Cousens' evidence on the subject of the silting up of the lakes?—Yes, I have, and I recognise that he is right in what concerns the lake of Geneva. In fact, only at Vevey the lake is pure as crystal. The case is, however, not the same at all. During the dry season there will of course not be any deposit at the weir, but in flood the velocity will still be very great near the weir. The section of the river near the weir would be 40,000 square metres. The discharge in flood can reach 8,800 cubic metres per second, and the velocity per second will still be three-quarters of a foot. This velocity is not sufficiently low even near the weir, so that the mud will deposit. It will then form a deposit behind the weir, where the velocity of the water below the top of the weir is nil. This deposit must be drawn out by tunnels in the weir.

2264. Have you checked Mr. Webb's calculations as to the quantity of water necessary for the mines?—Not entirely. I am of course not competent to speak on this subject, but I find that he speaks about five or six gallons per native. This is small. We must teach the natives to clean themselves also, and what about the sanitation on the mines? Just before the war the removal of the nightsoil on the mines had become a public calamity, and some mines spent enormous sums on installation of a plant to "cook" the nightsoil. I wish to burn it, not in a furnace, but in the bacteria beds and sewage farm, which is surely cheaper and more rational. A small supplement of water for this purpose, on the general provision, will be spent with benefit. Nothing prevents two neighbouring mines from using one plant on the limit between the two properties, and large farming along the mines may in this way succeed in bringing down the cost of mealies, and thereby the working expenses of the mines. I have not been able to find, either, what, in Mr. Webb's calculation, was provided for Krugersdorp, Germiston, and Boksburg. These will be three important towns, and will have to be provided with drainage as well.

2265. You notice it is mentioned, in the evidence, that a separate scheme is contemplated by the Consolidated Goldfields for the pumping of water from Olifant's Vlei?—Yes.

2266. Do you approve of such a scheme?—No; I not only disapprove of it, but I condemn it. I do not understand what this Commission is for, if each mine wants to go its own way. I thought the Secretary of the Chamber of Mines was speaking about working the low grade mines, profiting by the reduction of freight, customs duties, dynamite, etc. A separate policy for the water supply is to go right in the opposite direction to these wise rules of economy. It must be well understood that this water scheme is only possible if everybody goes shoulder to shoulder in the right direction, that is to say, a combined scheme for all the mines and all the townships under one administration.

2267. Can you give us any information about the price of water in European, American, and South African towns?—Yes; but it is difficult to know if the public service is included in the water-rates. In Paris the rate is 5s. per head of population per year. In the large French towns it is 4s., and in the smaller it is 3s. In England and America it is 4s. to 10s., and examples of 20s. are not rare. In Pretoria it is about 12s. A rate of 32s. per head of population in Johannesburg is then a large amount and may seem exorbitant, but in considering the absolutely unique circumstances, it is easily seen that it is not so extraordinary after all. If we compare the price per 1,000 gallons, it is much

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more favourable still. This is for distribution for household purposes only. We then have:—

	s.	d.
Paris, per 1,000 gallons ..	1	0
And for Industries, Elevators, etc.	2	2
Constantinople	3	3
Suburbs of Paris ... 1s. 6d. to	3	0
Versailles	2	2
Manchester	1	7
Moscow	1	5
Liverpool	0	11
Boston	0	10
New York	0	8
Philadelphia	2	0
San Francisco	1	11
Pretoria (sold by meter for household)	1	8
Average in Pretoria	0	5
Proposed for Johannesburg for household	1	3
And average (second canalization included)	0	9½

Where is, then, the exorbitant rate? The tariff based on rent is in Paris 16s. for £32. In proportion, for an ordinary rent of £12 per month, or £150 per annum, we would have 80s. per year, but this is, of course, for very small quantity. The prices which will have to be paid do not, then, constitute any extraordinary rates at all, taking into consideration the entirely exceptional local circumstances.

2268. Can you, in conclusion, recommend any one scheme or another?—No; this is entirely impossible. Instead of starting the necessary enquiries four or five years ago, when it was clearly seen that this project had to come, these four years—or, rather, the first two thereof—have been wasted with inconceivable neglect on the part of the former Government, so that now there is not sufficient information to hand for any man to recommend absolutely one thing or another. Rapid preliminary studies must first be made on the ground where the country is safe enough, and it will only then be possible to make comparative projects for each special case.

2269. (*Mr. Lance*, representing the Johannesburg Town Council.) I gather from your evidence that you consider the supply of water for the Rand should be taken from one source rather than from several?—Yes; that is my opinion.

2270. But as a matter of fact there is more than one source of supply available?—Yes.

2271. Then your idea, I gather, is that one source should be taken, and it should be supplemented by artificial means rather than taking two or three sources?—Two or three existing sources.

2272. Yes, natural sources?—Yes.

2273. In forming that opinion have you considered the difference in the cost between the laying perhaps of an extra pipe line and working a second source of supply, and the cost of artificially supplementing one supply?—Yes.

2274. Does that work out in favour of your artificial supply?—Yes, absolutely.

2275. The difference in cost works out in favour of artificially supplementing the one source of supply?—Yes, besides that it may be absolutely impossible to overcome the legal difficulties of several supplies.

2276. But you propose to deal with them by legislation?—Oh! that is a suggestion.

2277. By artificially supplementing a supply, you mean a system of what you call absorption dams?—Yes.

2278. And the source which you suggest primarily is that of the Klip River Valley?—No, you see the last answer in my evidence.

2279. I know your evidence. Will you give the Klip River Valley as an example, we will put it that way?—Yes.

2280. And I gather that in dealing with this Klip River Valley suggestion, you propose to put wells down at distances about a mile apart?—For the pumping up, yes.

2281. You propose putting these wells and also a number of dams?—Yes, wells in the dams for absorption.

2282. Would not this necessitate a considerable number of pumping-stations?—The twenty-two wells will represent twenty-two pumping-stations. As a temporary measure the twenty-two wells will be built, and the general gallery on the whole length will be completed afterwards by boring from every second well.

2283. In the meantime you would put down twenty-two separate pumping-stations, and all these twenty-two pumping-stations will be supplied from a central electric station at Vereeniging. You will have twenty-two stations which you have to erect?—Yes.

2284. This is until you construct what you call a "gallery"?—Yes.

2285. It will be a very expensive process?—Yes, £300,000.

2286. You still tell us that a scheme of this sort which would involve twenty-two different pumping-stations would be cheaper than adding another source with the one, two or three pumping-stations which may be necessary?—That is what I absolutely believe.

2287. You have given us an estimate of the cost of bringing in this Klip River supply. Have you worked that out in detail?—No, this was done three years ago.

2288. Then it cannot be taken as a reliable detailed estimate?—No, but very approximate.

2289. I understand that in dealing with the question of rainfall you have taken this Klip River Valley source only. You have taken the water-shed of that?—For this absorption scheme; yes.

2290. The Wonderfontein supply is another water-shed?—Yes.

2291. And Steenkopjes is still another?—Yes, that is what I am not absolutely certain of.

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2292. These are all in the dolomite. The Wonderfontein and the Steenkopjes are derived from the same basin?—Yes.

2293. Now, there is a very large area outside this Klip River Valley area of dolomite?—Yes; three times as much at least, or more than that, if you look at the map.

2294. We come now to the town's requirements. I see you give us for household purposes and water closets, or put down for domestic purposes, 5,500,000 gallons per day. That works out, I think, at 55 gallons per head?—Yes.

2295. Is that what you consider a proper supply for domestic purposes, for Europeans?—Yes, I have based my calculation on the supply to one house in this country, to six persons.

2296. I want to know if I am right in taking 55 gallons per head?—Yes. I do not say it is the same in every case. I think it could be reduced.

2297. You think that Mr. Andrews was somewhat under the mark?—Yes.

2298. You speak of using half of our town water over again?—Yes.

2299. As a secondary supply?—Yes.

2300. Before we go further, out of this 11,200,000 that you estimate, where do you propose to get the 5,600,000 from. I will just point out what I mean. You have got private gardens down at so much; the whole of that goes into the gardens does it not?—Yes.

2301. And the public service—the great bulk of that goes on the streets?—No, not all. There is:—

	Gallons.
Public Streets	960,000
Swimming Baths	200,000
Public Parks	133,000
Monumental Fountains ...	70,000
Public Abbatoirs	40,000
Drinking Fountains ...	2,000
Market	20,000
Tree Planting	30,000
Public Urinals	100,000
Public Offices, Gaols, Hotels, Barracks, Town Stables, &c.	100,000
Flushings to the drains ...	1,000,000
Sundries	20,000
Total for Public Service	2,675,000

2302. Upwards of a million of that is water that will not go away through the sewers?—I have a special calculation of that.

2303. The street water will not go away?—No, a certain part will of course be lost of this whole.

2304. Then you have gone into the question as to how much would be lost?—Four million two hundred thousand gallons would be lost.

2305. And the rest would run away through the sewers?—Yes.

2306. Would you have about six millions odd going to waste through the sewers?—Yes.

2307. Taking that figure, in dealing with that as you propose on your sewage farm, would you not lose more than a million?—I should not allow more than 1,400,000 go to the sewage farm.

2308. Is there not water lost in this treatment that you propose?—In the treatment by bacteria bed, none whatever.

2309. So you reckon you would have 5,000,000 as the result of the treatment?—Yes.

2310. Can you tell us of any place where this treatment is carried out and the water used again?—No, I cannot do that because it could only be in Johannesburg where such a scheme could be because of the exceptional circumstances.

2311. You do not know where it has been used?—No, but sterilization by peroxyde of chlorine is used in Ostende and Lectoure in France.

2312. I thought you quoted some German town where it was used for drinking purposes?—I said that the water coming from the drains—on the sewage farms—is used for drinking purposes on the farms in Paris and Berlin.

2313. They use it for drinking purposes?—Yes, absolutely.

2314. That is the water coming from the sewerage?—My water treated on bacteria beds and sterilized will be very much better.

2315. Then we are right in assuming that it is a scientific process which is recommended by you, and you do not know whether it has been put in practical use?—It will have to be tried first to see if it is possible to do it. I cannot put myself down as an oracle.

2316. You would get this water which you propose to give us at the point of the outfall of the sewer?—Yes.

2317. That would be about eight or ten miles out of town?—No, one mile or in the town.

2318. Do you think it practicable to have the outfall of the sewer on the farm so near the town?—No, on the bacteria bed.

2319. Then you do not propose to take this water down to the sewage farm?—No.

2320. To deal with it specially a short distance out of the town?—Yes.

2321. Is that it?—Yes.

2322. I thought you said that a great deal of this water would come down the sewers?—One million four hundred thousand gallons, which could not be used afterwards, would go down to the sewage farm.

2323. But the outflow from the town is in the sewers, is it not?—Yes, you must calculate that on 100,000 inhabitants there must be 11,200,000 gallons used, and of this 5,600,000 is purified again in the septic tanks and the bacteria beds.

2324. How do you take this 5,600,000 gallons to the septic tanks and bacteria beds?—By an outfall sewer.

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2325. Is it not through an ordinary sewer?—Yes.

2326. That is to say you make an outfall from the sewer at a point nearer the town for these beds?—All sewage must first go to the bacteria beds.

2327. This 5,600,000 gallons goes away into the sewers?—Yes; but it is not 5,600,000, you have 11,000,000 gallons.

2328. It does not all go into the sewers, part goes into the streets and gardens?—I recognise that myself.

2329. What I want to get at is this. Your sewers go right away to a sewage farm which may be eight or ten miles away?—A small quantity goes there.

2330. You say your bacteria beds are near the town?—Yes.

2331. How do you get the water out of the sewers there? Do you make a special outfall?—No, that is the general outfall sewer which goes first to the bacteria bed.

2332. And then goes on to the farm?—When it is purified, one part, 1,400,000 gallons, goes to the sewage farm and 5,600,000 gallons is pumped out to the town again.

2333. Then this purifying process of the sewage takes place near town?—Yes.

2334. The sewage itself is all emptied out in the town?—It first goes to the septic tank, which is absolutely covered where the gases are burnt, and after that it is laid out on these bacteria beds which do not develop any smell.

2335. It involves the treatment of sewage near the town?—Yes; but if necessary you can go further away.

2336. Have you ever been in any place where they treated sewage in this way—with bacteria beds?—No; I have not been in Europe for four years, but I have had elaborate reports from the chief engineers in Paris, and there is no doubt about its practicability.

2337. Have they reported on the smell that takes place?—Yes; the smell is very great if the septic tanks are not covered up, but when they are covered up there is no smell whatever.

2338. You cannot quote anything from your actual knowledge?—No.

2339. This water would have to be pumped up again?—Yes.

2340. Have you reckoned the cost of that?—Yes; but the other water coming from below has also to be pumped.

2341. The natural water has to be pumped. Is there no great difference in the cost o pumping?—There could possibly be no difference.

2342. Will it cost as much to pump this five million gallons up again as it costs us to pump the same quantity from elsewhere?—No, only 1s.

2343. You have given us an estimate of what we are going to save by using this water over again?—Yes.

2344. In that I do not see anything allowed for pumping?—The pumping of the water from below is calculated to a price of 5d. per thousand gallons, which is low, and in that way, with 5,600,000 gallons per day, the annual sum would be £42,583.

2345. How do you make out what we are going to save?—That is, of course, the whole thing.

2346. You give us £23,500 as what this purification scheme and second pipe is going to cost?—Yes.

2347. What are you going to save?—£19,100.

2348. That is, the difference between £42,600 and the £23,500?—Yes.

2349. So that the £23,500 is what you put down as the cost of using this water over again?—Yes.

2350. In that I do not see any allowance for pumping it up?—The pumping expenses are the same in the two cases. Whether you pump clean water or the purified water the expenses of pumping are the same.

2351. But the £42,600 is the same?—The £42,600 is the cost of the water at the "door" of Johannesburg.

2352. What I want to get at is the cost of pumping it from the place where you purify it to the service reservoir. You have not given us that?—No, this £42,583 does not include the pumping up to the service reservoir. This is at the "door" of Johannesburg.

2353. What is the door?—At the lower end.

2354. At the lowest point?—Yes.

2355. And you reckon that would be in point of level the same point as you deal with this secondary water?—Yes, practically the same.

2356. Taking your own figures, you say we should save £19,000 a year?—Yes.

2357. That, on the consumption you estimate for, amounts to about 2d a thousand gallons?—No.

2358. If 5d. comes to £42,600, it is a fraction above 2d?—Yes.

2359. About 2¼d., is it not?—Yes.

2360. 2¼d. per thousand gallons is to be the inducement for us to use the water over again?—Yes.

2361. It will involve a second system of pipes right through the town, will it not?—Yes, but that is all included.

2362. I mean, we have the net gain. Now I want to see what the disadvantages are against this. There is the inconvenience of a second pipe system right through the town?—That is not an inconvenience. That is a very great and enormous convenience.

2363. You do not think it would be an inconvenience?—None whatever; it is a convenience.

2364. Then there is the second system of taps?—Yes.

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2365. Would there not be a danger of getting the water mixed?—No, it cannot mix in the pipes.

2366. But after it comes out of the pipes?—No, this second class water is not to be used anywhere inside the house.

2367. You would have a tap out in the garden, say?—Yes, but of these taps one can be nickel and the other can be brass, and besides I have explained this water is harmless.

2368. It would not hurt children should they make a mistake and take water from the wrong tap?—No.

2369. If that is so, why do you want a second system of pipes at all?—Because that supply will certainly be inferior to a good natural water supply for drinking purposes.

2370. It would be inferior?—Yes, it contains so much more nitrate.

2371. Would it not be harmful?—No, it is rather that we think that it is harmful.

2372. But the inferiority is sufficient to warrant you going to the enormous expense of laying two sets of pipes?—That is not an enormous expense.

2373. It is £200,000?—That is nothing.

2374. Well then, another thing we should have to have in every house these grease boxes?—Yes, but that you have to have in every case.

2375. Why?—Because anywhere where there is a sewer existing, they have found it impossible to run the sewage without the grease boxes, and I go even so far as to say that the most important point of a sewage system is to have a grease box at each kitchen sink.

2376. Do you not think it is likely that in a process such as you recommend you would be liable to accidents occurring through insufficiently skilled labour?—No, this purification station would most naturally be under the control of a very skilful chemist.

2377. A very skilful chemist?—Not so very skilful.

2378. If things were not carried out properly, then there would be the danger of the water being harmful?—No, I do not think so.

2379. Not even then?—No.

2380. This purified water would be better than they are drinking in Paris?—No, not drinking, but for street-watering, and all the other public purposes for which it can be used.

2381. Have they a double pipe system in Paris?—Yes, all over the town.

2382. In view of this small saving of 2¼d. a thousand gallons, do you not think it would be much more satisfactory to have natural water at once if we can get it?—I should say, first, that the saving of 2¼d. a thousand gallons is not small, and, secondly, I do not see where the water is going to be got.

2383. That brings us back to the point we were at first. You estimate that you can get 30 million gallons from this Klip River Valley?—Yes.

2384. Cannot you add to that, say, from the Wonderfontein Valley and from Steenkopjes?—Yes, but then we have not to calculate any longer on the 1s. 3d. for natural water.

2385. It will cost more?—Yes.

2385. Would there be any great difference in the cost?—No, I have only made an approximate calculation to see that I was right.

2387. The difference in cost would not be very great?—Yes, the difference in cost would be very great.

2388. It would be?—If one source of supply could possibly deliver sufficient for Johannesburg for all purposes at a very low cost, I do not think myself that the second pipenet would be necessary.

2389. But seeing that one source such as you suggest may not be sufficient, you would recommend us to use this water over again rather than supplement it from another source?—Yes.

2390. (*Mr. Thomson*, representing the Johannesburg Waterworks Company.) Have you had any actual control of the inauguration of waterworks for any town?—Yes, when I was Assistant Town Engineer at Bordeaux, we doubled the system about.

2391. You have never inaugurated a system or had the sole control of the water system for any town?—For the building of a water system?

2392. For the construction of the whole scheme?—No.

2393. And the bulk of the evidence you have given us is theory based on your studies or researches?—Yes, but if it is theory in such a case, I cannot see where the practice could come in.

2394. You are really a railway engineer. That is the branch of your profession that you follow?—No, not at all. I consider that I have had as much practice in water or sanitary engineering as in railway engineering.

2395. You are not an Associate or a Member of the Civil Engineers?—No, I have not got that honour yet.

2396. You hope to get it yet?—Yes, some day.

2397. I notice in your answer about the Vaal River, that the gauging you took was immediately after the rainy season—April and May?—Yes.

2398. When there was a strong stream flowing?—No, there was no strong stream in April and May.

2399. When is it strongest?—At the rainy season.

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2400. When is it at its lowest?—The lowest would naturally be in October or November.

2401. Six months after you took the gauging?—Yes.

2402. Do you know that sometimes the average flow of the Vaal River has been less than ten million gallons a day?—I should not be astonished if it was.

2403. Would you be astonished to hear that it ceased flowing altogether?—No, I should not be astonished to hear that it ceased flowing altogether.

2404. And still you think that the Vaal River can supply 30 or 40 million gallons a day?—No, I have not said that. I have said that that is the very maximum.

2405. You first of all put it down at 100 millions?—I said that it was based on a proportion taken of the true drainage areas which by no means can be estimated as a gauging of the stream, and, of course, it means the absolute maximum.

2406. I take your own evidence. First of all you estimated it at one hundred millions, and then you say that "as none of these spruits are as large as the Vaal, this is apparently exaggerated, and thirty to forty million gallons would be nearer the correct amount, or not much more than the Rand and Johannesburg require." Do you still estimate it at that?—No: I should not be astonished myself if there was only ten million gallons.

2407. Therefore the Vaal would be an uncertain source?—Yes; without a dam it would be an uncertain source.

2408. Where do you propose to make a dam?—That I do not know.

2409. You have given us estimates of the cost, you speak of delivering at 7d., so you must have some idea of it?—I have the section of the river over a certain distance.

2410. Have you made a survey of any portion of the river where it is possible to make a dam?—No; I have gone from the railway plans which is a sufficient survey for such a purpose.

2411. On what premises do you base your estimate that you have given us in your evidence for the cost of the survey and the price you are going to deliver it?—That is in the notes.* I have handed in the whole calculation.

2412. I want to know from you. I cannot refer to the notes at this moment. I want to know on what data you base those figures of yours in connection with the Vaal River Scheme?—Then you had better take the notes.

2413. Surely you can state on what you base your figures. In the fourth question in your evidence your calculation shows the sum of £1,320,000. I want to know how you arrive at that, seeing that you made no surveys of a dam site or pipe line, or anything else?—I will read the estimate.

* See Appendix H. 3.

2414. Give me the cost of your dam in the Vaal River?—That you have in the evidence.

2415. How do you arrive at the figures if you never made a survey? How do you estimate the cost of the dam in the Vaal River?—Any engineer can estimate that without making a survey.

2416. This is just a rough calculation?—Yes.

2417. The same for the length of pipe line?—No; there you have the map to go upon.

2418. Then you should know where you propose to have your dam?—This scheme was first made up without any dam, based on 100,000,000 gallons.

2419. You tell us that the pipe line is easily estimated because you know the length of it?—Yes.

2420. Therefore from Johannesburg you can give us a point on the Vaal River that you based your estimate on?—From Vereeniging.

2421. What is the price for the dam?—£300,000, I think.

2422. And the pipe line?—The pipe line was £530,000.

2423. That is for one pipe—a single pipe?—Yes.

2424. What diameter?—The diameter was, I think, 1·25.

2425. Was it a 16 inch or a 24 inch pipe?—No, 1·20 metre to 1·30 metre—that is, five feet diameter.

2426. Five feet diameter?—No, 4 to 4½ ft.

2427. And you consider it would be judicious to have one pipe of that size rather than a double set of pipes of a smaller diameter?—Yes.

2428. In case of breakages or accidents?—Yes, the accidents are none.

2429. Would you advise a single line of pipe of this large diameter in place of two pipes running alongside each other of less diameter?—Yes, absolutely.

2430. Notwithstanding any possible accidents or breakages?—There are no breakages to be feared if they are properly made and if there were any small accidents the reservoirs are there for this purpose.

2431. What about a charge of dynamite?—A charge of dynamite would blow up the two pipes as well as the one.

2432. Can you tell us of any instance where water is pumped under these conditions?—All the big supplies to Paris are conveyed by a single pipe. New York also has a single pipe.

2433. Under the same conditions?—Yes, there is no practical difference.

2434. What height do they pump?—You will find that I say for such a large pipe as that it is not advisable to have only a single pump station. You have to avoid the thicknesses of plate of more than nine or ten millimetres. For that you would want three or four pumping stations.

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2435. You would not require so many for the pipes of smaller diameter?—No, you could possibly save one pumping station.

2436. And that of course lessens the price?—Yes, the price of pumping.

2437. What quantity of coal would it take per hour per horse-power?—1·33 kilogrammes.

2438. Not 1·2?—I have estimated it here at 1·33 kilogrammes of coal—that is, three pounds of coal for one horse power per hour.

2439. Why have you now altered your estimate; you first of all said 1·2?—It is between the two. One-tenth of a lb. of coal is not of very great importance.

2440. What quality of coal would that be?—The same coal as used in Pretoria for the Electric Lighting works.

2441. Do you get that at Vereeniging?—No, but Vereeniging coal is even better.

2442. Would you be surprised to hear that it takes 5 lbs. of coal per horse-power per hour?—That depends absolutely on the steam engine. There are bad sorts and good sorts.

2443. So you cannot lay it down as a hard and fast rule then, that you require 3 lbs of coal?—No, this depends naturally on the coal you get. You understand that this is approximate, and not definite.

2444. Would that affect the price of water? You say that you can supply it at 7d., but can you do that supposing it takes 5 lbs. of coal per hour per horse-power instead of 3 lbs.?—That will affect it a penny a thousand gallons.

2445. If you use nearly double the quantity of coal?—Yes, but it is not nearly double.

2446. You have given evidence about Steenkopjes. Have you been on the place?—No, not on Steenkopjes. I do not know anything about it.

2447. You do not know anything about the configuration of the country?—No, except what I have seen on Major Jackson's last map, which is better than the one I have here.

2448. You have told us that Steenkopjes water and the Wonderfontein water is really one and the same basin?—That is, from the same watershed, yes.

2449. From the same basin?—Yes.

2450. Do you know Olifantsvlei, which is close to Steenkopjes?—No.

2451. Would you be surprised to hear that the water from there flows in a directly opposite direction to that flowing from Steenkopjes?—How far is that from Steenkopjes?

2452. A few miles—15 miles?—Then it flows against the Wonderfontein. There is always a dividing line, but it is very difficult to know where it is.

2453. Wonderfontein flows into the Vaal River?—Yes, from the same catchment basin but not from the same river basin, because on the underground the dividing line very seldom corresponds with the surface dividing line.

2454. With regard to Steenkopjes, you would not venture to contradict the evidence of Mr. Stewart, who has made exhaustive examinations?—No, I have never had the slightest intention to contradict his evidence.

2455. You have read the evidence of Mr. Willcocks?—Yes, I have the report here.

2456. You notice that both Mr. Willcocks and Mr. Stewart say in their evidence that there is sufficient water in the dolomite to supply the whole of Johannesburg and the mines?—Mr. Willcocks supposes an infiltration of three inches.

2457. You have heard what they say, that there is sufficient water in the dolomite for Johannesburg and the mines?—That depends absolutely——

2458. Have you or have you not?—Yes.

2459. You think they are both wrong?—Mr. Willcocks is not wrong in the quantity to be got from the formation, but he is entirely wrong in the quantity he supposes to be sufficient, and these are two widely different things.

2460. And Mr. Stewart?—He estimates 30 gallons a day for everything. I think it is not enough.

2461. But you have told us that 10 gallons is enough?—No, I have said that 20 gallons was too much, because there is nothing now to carry it away. Ten gallons is all that can possibly be carried away unless we have another system.

2462. Your figures are so contradictory. In question 2214 you tell us you provided 55 gallons per head?—Yes, 55 gallons per head plus what is used over again.

2463. And in question 2201 you say that 6,000,000 is sufficient, and in question 2214 you tell us that 55 gallons for domestic purposes only, or a total of 11,200,000 gallons?—That is water that has to be used over again.

2464. Would you seriously recommend the Government instead of utilising the water which is said to be in sufficient quantities in the dolomite, to use water from sewage pipes—you are perfectly serious?—Yes, perfectly serious.

2465. (*Mr. Dumat*, representing Mr. Goch.) You talk about a report which you made in 1897 or 1898, are you at liberty to tell me for whom that report was made?—No, I do not think I am.

2466. I suppose in any case the people for whom you made that report did not think it worth their while to go on with the extensive geological, hydrological and hydrographical survey, which you say is necessary before anything very definite can be predicted about this scheme that you now suggest?—I considered it was the Government's duty at that time to do it.

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2367. Then your report was for the Government?—(No reply.)

2368. You say that the scheme you now put forward is a suggestive plan?—Yes.

2469. And you say that this suggestive scheme of yours depends upon a proper survey of the whole question first?—Yes.

2470. Upon a preliminary study of it?—Yes.

2471. How long do you think such a study would take?—Six months.

2472. If it were a Government supporting one?—Yes.

2473. With a large staff of men?—Yes.

2474. In the meantime supposing the scheme was adopted and you started this series of wells which you talk of—the twenty-two wells—for the purpose of sinking them and pumping the water out of them while you are sinking, do you suggest that an electric plant should be established at Vereeniging for the supply of power?—Yes, the plant could be erected.

2475. And if you found after you had started your galleries at the bottom of these wells that you had to extend them until you made a gallery of twenty-two miles, and you found then that your supply of water was not adequate to the demands of the town, that plant and the expense of these galleries and wells would be a dead loss to the country?—Yes, but that is impossible; such a thing could not happen.

2476. That is your opinion?—Yes. It is my opinion that it would be a dead loss, if such a thing could happen.

2477. In your opinion it cannot happen?—No.

2478. Can you give us any idea of the time that would be needed to cut through this twenty-two miles of drive?—Yes. I have given it somewhere in my report. I think it is ten months, because the work is proceeding from every second well.

2479. Yes, but you start from every alternate well?—Yes, every second well. That is how I have calculated it.

2480. Would you drive twenty-two miles of galleries in ten months?—Yes.

2481. You would have twenty-two faces?—No; only eleven to pump from.

2482. And you would do twenty-two miles of gallery in ten months?—Yes.

2483. This drive or gallery of yours, would it be on the floor of the dolomite?—No; you have to go 150 feet in the dolomite. As near to the bottom of the formation as possible, because the dolomite does not go to the centre of the earth.

2484. You would go as near to the centre of the dolomite as you could?—Yes; I should say 150 feet.

2485. What is the thickness of the dolomite?—That I do not know.

2486. I suggest it to you, as given in a work of De Launey's by Dr. Hatch, as 6,000 feet?—Not all over.

2487. That is the average thickness of the strata?—That is on the north side of the Rand.

2488. No, on that formation just above the Black Reef?—If they estimate it at that, so much the better.

2489. What do you think the dip of the Black Reef is in that Klip River Valley. It lies fairly flat, does it not—that is, the Black Reef?—Yes. It dips about ten degrees—the dolomite does not seem to dip so much.

2490. The Black Reef dips about ten degrees?—Yes.

2491. Now, your eleventh well from Vereeniging would, I think, if you take the map and sketch it off, be about seven miles from the outcrop of the Black Reef?—On the east side.

2492. No, the south. Take your line of wells running north, and then roughly the centre of this line of wells would be about seven miles from the Black Reef?—East or west.

2493. Going towards the south?—But the Black Reef does not come out on this side of the Vaal.

2494. You have the Black Reef outcropping East and West?—Yes.

2495. Stand on the outcrop and look south. The centre of your line of wells which run North and South would be roughly between seven and eight miles from the outcrop of the Black Reef, where you would be standing. Am I not clear? Draw a line through Vereeniging North and South and eventually cutting the Black Reef at the North end of it. The distance between Vereeniging and the northern end of that line which is about 22 miles, your central well on that line would be half-way, or about eleven miles from Vereeniging, or eleven miles from the Black Reef?—No, it would be almost parallel to that north line.

2496. The position of your central well?—Yes.

2497. It would be about eight or eleven miles?—Yes.

2498. You go down in that central well to about the middle of the dolomite?—No, about 150 feet.

2499. My data rules that the dolomite formation is about 6,000 feet thick, and therefore if that is correct it means that to get to the middle of the bed of dolomite besides passing through the upper sandstone formation you would have to sink 3,000 feet?—150 feet is quite sufficient.

2500. Where do you get the data that makes you think that?—Because I then got sufficient pressure from above to bring the water to the wells. That 150 feet is to create an artificial pressure behind.

2501. Where did you get the figure on which you base that—that if you start from the surface you get to the dolomite after you sink 150 feet?—The dolomite is on the surface.

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Mr. A. Karlson.

January 27, 1902.

2502. Where; at the centre of this Klip River basin?—It is not much below.

2503. I look at the map and see a large belt of blue stone?—It is all the way along the railway line.

2504. I also see a large broad band of sandstone?—That is shale.

2505. Which overlies the dolomite?—I am not going there at all except for the dam which may be used as an absorption dam on this slate formation.

2506. Do I understand then, that for the 22 miles you can start your wells right on the dolomite itself—that is. from the Klip River to Vereeniging?—Exactly; yes, or not far from it.

2507. You go 150 feet into that bed of 6,000 feet of dolomite?—Yes.

2508. The principle which is at the bottom of your scheme is this, that through a gallery you will draw 30 million gallons a day?—Yes.

2509. So as not to eventually exhaust the water stored in the dolomite you will have a series of what you call small and cheap dams which will store the rain water and will supply it to the dolomite at the rate at which you draw it from the dolomite—that is, at the rate of 30 million gallons a day?—Yes.

2510. How many of these small and cheap dams do you propose to put on this area of 900 square kilometres?—I calculated six or seven.

2511. Only six or seven small dams, and you are going to knock the bottom out of them?—In these dams there will be bore-holes six inches in diameter.

2512. How do you propose to prevent these boreholes silting up when the floods bring down gravel and so on to the dam?—There are filter plates fixed on the top of each well.

2513. And that filter will have to filter all the water which that dam accumulates?—Yes.

2514. Do you mean sand filters?—No, that is to be a special plate. A special sandstone plate made for the purpose. It does not mean to take away the microbes, but only to take away the mud. It is a compressed sand pipe. There are many filters made now even for large towns of the sandstone plate.

2515. Do I understand that you mean a large slab of sandstone?—A large slab of artificial sandstone through which the water has to pass.

2516. How long to you think it would take to clog?—Well, it has to be cleaned.

2517. Do you have to dry your dam each time you clean it?—There is no difficulty, you can easily brush beneath the water surface or filter plates.

2518. You said that you had about seven of these dams?—Yes, I had calculated on that number.

2519. In any case you have seven on this plan?—Yes.

2520. Now the seven dams together would have to give 30 million gallons a day?—Yes.

2521. Through these bore holes?—They have to go through much more.

2521*a*. Thirty million gallons a day?—Yes.

2522. If there were seven dams, roughly it means that four million gallons a day would have to percolate in these bore-holes of yours in each dam?—Yes.

2523. I presume these dams ought to be able to hold in wet weather 30 days' supply.

(*To the Acting Chairman.*) I am trying to get at the capacity of these dams, and I think I shall be able to show that each dam would have to be about twice the size of the Rosherville dam.

(*To the Witness*). We have then 30 million gallons a day to be provided from seven wells?—You must remember this project was made up for 22 million gallons.

2524. We take the new project?—You will have to increase the dams in proportion.

2525. If you jot my figures down you can calculate them because they are all simple figures. We have 30 million gallons distributed in seven dams. Seven dams give 30 million gallons a day?—Yes.

2526. That means for each dam an output of four million gallons per day, roughly?—Yes.

2527. These dams ought to be able to hold in the rainy weather a month's supply?—Your calculation is based on the wrong theory.

2528. I want you to stop me then?—You are wrong from the beginning.

2529. Tell me what it is?—The best I can do is to read the two pages of the Special Note.

2530. I would rather not?—I do not know how to explain it otherwise. The dams have to give down to the ground very much more than four million gallons a day.

2531. I will be satisfied with the four millions?—I mean because you cannot store it in the dams.

2532. I want you simply to think this. that each dam has got to give out four million gallons a day, so that you can draw altogether 30 million gallons a day. Now each dam must, during the rainy season. hold, we will say, 30 days' supply?—No, it does not. It filters at a very much greater rate than four million gallons a day.

2533. If it gives out four million gallons a day, we must put four million gallons in it in any case?—No, because I cannot make the dams big enough to contain storage capacity. The dams are not made for storage. They have to filter as soon as possible.

2534. Surely it would hold 30 days' storage?—Not at all.

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2535. What is it going to hold during seven months of the year?—They are going to hold nothing during the dry season; they will be entirely dry.

2536. Where will you store all your water during the rainy season?—Below the ground as it is at present.

2537. Then you think it is possible that these boreholes when put at the bottom of the dam will pass you into the dolomite 50 thousand million gallons of water in about four or five months?—No, we only want eight thousand million gallons.

2538. You must collect 50 thousand million gallons—you must pass that into the dolomite according to your own figures. You say in your evidence "A total rainfall of 10 inches collected on 900 square kilometres would give in all 50,000 million gallons, or per day 140 millions, of which we could be quite certain to collect lower down the necessary 30 millions"?—That does not mean to say that I suppose all that will go into the ground.

2539. You say this, that with the total rainfall of 25 inches you suppose that 10 inches will sink down through your upper surface into the dolomite?—Yes, that is quite possible, and it will be explained if you will let me read these two pages.

2540. And to the very same question you say: "In order to increase the absorption power of the ground, wells should be bored in those lakes to a certain depth in the dolomite formation, and blasted out at the bottom. If these dams are situated at a high level, and the wells or gallery of collection very deep, there will be no difficulty to collect in these dams and absorb by them half of the rainfall, which otherwise would go to the sea." That is clearly that you want to absorb ten inches of the rainfall into your dolomite from your wells?—Yes, it can be done but it is not absolutely necessary.

2541. And going on, you say: "By the long distance between the absorption dams and the collection wells the supply will be made, if not absolutely of constant capacity, then at least very nearly so. A total rainfall of ten inches, collected on 900 square kilometres would give in all 50,000 million gallons, or per day 140 million gallons, of which we could be quite certain to collect lower down the necessary 30 million gallons." That is to say, 50,000 million gallons would get into the dolomite somehow or other, and you would tap it at the rate of 30 million gallons a day?—Yes.

2542. And you say that this supply of 50,000 million gallons would pass to the dolomite from these boreholes at the bottom without dams?—Yes.

2543. Therefore your bore-holes would have to pass from the surface down into the dolomite 50,000 million gallons of water?—In one year, yes.

2544. Less than a year?—Yes, in less than a year, four months.

2545. Do you think they would do this with these blocks of sandstone on top—these six-inch bore-holes?—They are not plugged up by a block of sandstone.

2546. If it is obturated?—Yes.

The Commission then adjourned.

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WITWATERSRAND WATER SUPPLY COMMISSION.

MINUTES OF EVIDENCE.

EIGHTH SITTING.

CHAMBER ROOM, TOWN COUNCIL, JOHANNESBURG.

MONDAY, 3RD FEBRUARY, 1902.

Present:

W. ST. JOHN CARR, ESQ. (ACTING CHAIRMAN).

A. BRAKHAN, ESQ., W. McCALLUM, ESQ.,
B. KITZINGER, ESQ., J. W. QUINN, ESQ.,

G. CRAIG SELLAR, ESQ., SECRETARY.

(*Mr. St. John Carr.*) The Chairman is still indisposed, and I have been asked by the Government to take the Chair.

Mr. AUGUST KARLSON, City Engineer, Pretoria, called and further examined:

Mr. A. Karlson. February 3, 1902.

2547. (*Mr. Dumat*, representing Mr. Goch.) Mr. Karlson, at the last sitting of the Commission I was asking you for information about the capacity of these dams, of these absorption dams, which you suggested should supply the dolomite with an amount of water equivalent to that which you would draw from it through your galleries?—Exactly.

2548. And you pointed out to me that I was in danger of over estimating the capacity of those dams because I was overlooking the fact that the bore-wells would carry off a large proportion of the water as it came into the dams, and that therefore the storage capacity would be less than that which I was inclined to reckon?—Yes.

2549. I believe you suggest for the purpose of draining 900 square kilometres, 7 dams?—7 or 8 dams, yes.

2550. And this is draining 10 inches of water off the surface of these 900 square kilometres?—If it is possible, yes.

2551. Do you think it is possible to so locate 7 or 8 dams in that district as to drain or catch the surface water off the 900 square kilometres?—Yes, it is very steep ground all over, but I should not say it would be possible every year.

2552. You don't think it will be possible every year?—No, but that is not necessary either.

2553. These 900 square kilometres make 347 square miles, do they not?

(*The Acting Chairman.*) 900 square kilometres.

(*Mr. Dumat.*) Is that correct?—Yes, it is something about that.

2554. We will call it 350. It does not matter. Now as these absorption dams are meant to convey the surface water into the dolomite, the most favourable conditions for the purpose would be the conditions of an equal rainfall through the 150 days of rainy season?—The most favourable, yes.

2555. So as to have the smallest dams possible?—No, that would be wrong, because if there was an equal rainfall during the 150 days there would never come a drop of water into the dams.

2556. You don't follow me. You say that the dams are not to be used so much as storage dams as really receptacles for passing water through into the dolomite?—Yes.

2557. And therefore they need not have a capacity necessary to store the rainfall, but only capacity sufficient to pass the rain fall through the bore-wells into the dolomite?—Exactly, yes.

2558. Therefore the most favourable conditions for that purpose, what I might call the ideal conditions, would be a regular rainfall through these 150 days?—Yes.

2559. Is not that so?—Yes.

2560. How many of these bore-wells do you propose to put from these dams into the dolomite?—I calculate 1000.

2561. 1000 bore-wells?—Yes.

2562. How deep do you reckon these bore-wells will be?—50 metres or 150 feet.

2563. Now you put that large number, I suppose, because you expect that there will be some back pressure into those 6 inch tubes?—Pressure from the surface, yes.

2564. Not from below?—No.

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2565. You don't expect that the water will flow through these bore-wells as fast as it would through an open tube?—Oh, no.

2566. Therefore you allow a larger number of bore-wells than would be sufficient or necessary to carry the water through if the outlet of the pipes remained open?—Yes, the duty of an absorption well is that it can absorb as much water as any well can give in pumping from it.

2567. In Question No. 2179 you refer to the possibility of two or more water supplies instead of one large one. You said, and very properly so, that the expense of several pumping stations, which would be necessitated by three or four different sources of supply, would be larger than if your supply was derived from one source?—Yes.

2568. Does it not occur to you that this very objection, which you have to different sources of supply, applies in an exceedingly potent way to the twenty-two wells or twenty-two sources of supply you propose to have in your scheme of water supply?—Yes, that is true, but these wells are going to be electrically driven, requiring a very much smaller personnel, and besides, as I pointed out, most of these pumping stations will disappear when the gallery is finished.

2569. But you have several all the same?—For the lifts, yes.

2570. Yes, for lifting the water from the gallery to the surface?—Yes, and from the surface to 100 metres, and from 100 metres up to Johannesburg.

2571. I mean different sources from the gallery. Thus you will have several pumping stations even when your gallery is completed?—Yes, but they can be reduced to three or four.

2572. And each well from which you pump the water, say three or four, will be provided with a pump?—Yes, but electrically driven.

2573. And then you want these personally looked after?—Yes, but that is only two men.

2574. Now, we were told at the last meeting that the bore wells would be kept free and open by means of filters which would protect their mouths?—Yes.

2575. And I asked you whether you would use sand filters, and you said sandstone filters. Will you tell me, or rather describe to the Commission and myself, what is the nature of the sandstone filters with which you intend to protect the bore wells?—The system is the same as an ordinary Berkenfeld or the Howatson filter.

2576. You propose then to put a sandstone candle——.—Not a candle, a plate.

2577. A sandstone plate over the top of each bore well?—Yes.

2578. A square box with four plates?—Yes.

2579. A cube in fact?—Yes.

2580. Into the lower part of which the tube would be introduced?—Exactly.

2581. And the opening of the tube would be wholly inside the cube?—Yes.

2582. What would be the area of each side of the cube?—One metre in each side.

2583. A yard cube roughly?—Yes.

2584. That would give you six square yards of filtering surface?—About that, yes.

2585. Has that system of filtration through sandstone ever been adopted in practice for large waterworks?—Yes, that is the Kurka filter.

2586. I would like to go into some figures with you. They are very simple and won't require previous preparation. Taking these very advantageous conditions of an equal rainfall during the 150 days, and taking the total rainfall to be collected during these 150 days, as fifty thousand million gallons, and dividing your fifty thousand millions amongst seven dams, you would have to pass forty-seven million gallons each day through each dam?—I worked out the calculation on eight dams.

2587. You will find we have an ample margin. You need not be nervous about seven or eight dams.—Yes, but these are my figures and I have calculated them on eight dams.

2588. You see, taking fifty thousand million gallons and dividing by seven, that is the number of your dams, it gives you per dam seven thousand one hundred and forty-three million gallons. That is for 150 days.—Yes, that would come to over seven thousand one hundred and forty million gallons.

2589. But that is for five months, and dividing that by one hundred and fifty you get the daily flow of water through each dam at forty-seven million gallons?—I tell you it is very difficult for me to calculate it, as I am very slow in thinking in gallons.

2590. I will tell you what I did. I divided fifty thousand by seven, never mind the million gallons.

(*The Acting Chairman.*) In regard to that fifty thousand million gallons, you take that as the rainfall caught in the catchment area you refer to.

(*Mr. Dumat.*) Yes, the scheme supposes a rainfall of 25 inches and then Mr. Karlson says of that I want to get fifty thousand million gallons and it will be sufficient if I get ten inches of that twenty-five inches to provide the fifty thousand million gallons. Those fifty thousand million gallons I am going to direct into my absorption wells and from them into my dolomite and then draw them out at the rate of thirteen million gallons per day, allowing for waste, etc.—Now I can tell you what it comes to. It is forty-seven million gallons per dam per day.

2591. Right. Now that of course is under ideal conditions?—Yes.

2592. You know that sometimes we get here during a rainy season rain for three or four days and then we won't get rain for a fortnight?—Yes.

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Mr. A. Karlson. February 8, 1902.

2593. I would like to put these figures to you, Mr. Karlson. I may state, for the information of the Commission, that the Kurka system of filtration through sandstone has been applied, I believe, in Germany, and really consists in filtration through candles similar to the Birkfeld or Pasteur candles only on a very much larger scale. They are four feet high, nine inches in diameter and two and three-quarter inches thick. What I propose to put before the Commission, through Mr. Karlson, is this, that the area of each candle, the developed area, is ten square feet and that under proper conditions of cleaning, *i.e.*, cleaning every six hours by a special process of flooding the candles with filtered water, in the reverse direction to that in which the dirty water filters through them the candles will filter or allow to pass, each candle with an area of ten square feet, 614 gallons every twenty-four hours. Are you aware of these figures, Mr. Karlson? —Yes.

2594. I take them from Kurka's prospectus, where he naturally does not under estimate the working capacity of the system.—Yes, but you misunderstand entirely. These Kurka filters are to keep microbes out. You can make such a filter with any filtering capacity you like.

2595. I know. I am going to allow you a larger power of filtering than that. The figures I have given allow for cleaning every six hours. Kurka says that with these microbe filters of his, if you only clean them every twenty-four hours, you decrease the efficiency by one half?—Yes, that is for microbes but this filter is not for microbes.

2596. Now of course what you want to do here is not to filter off microbes but you want to get rid of the mud, silt and clay, which would otherwise block up your bore wells?—Yes.

2597. And, therefore, you can afford to adopt a much more rapid, although a less perfect system of filtration, is that not so? —Yes, exactly.

2598. You would not be able to clean the filters or cubes of sandstone more than once in twenty-four hours?—No. I would say it would be sufficient if they were cleaned once every three or four days.

2599. We will take it once every twenty-four hours. Do you think then it would be sufficient to allow the full rate of filtration of Kurka's candles, with a cleaning of once every six hours, where you only clean once every three or four days?—Oh, no, we could not take the velocity of filtering from Kurka's filters as a basis. These filters have to be made of very much looser material.

2600. They would be made of sandstone? —No, they would be of artificial sandstone, the same as the Kurka filter.

2601. Do you think that artificial sandstone would filter twice as fast?—I made experiments on the ordinary Howatson filter and I found a filtration of 200 metres a day.

2602. Cubic metres?—Yes, if you like, per square metre. Every square metre filters through 200 cubic metre a day. I only calculated it last night.

2603. But I find the metre rather puts me out. How many gallons would that be? —That is 45,000 gallons per square metre.

2604. Then these sandstone filters would actually filter water quicker than loose sand does?—Yes, it depends on the depth of the sand. They might have a thickness of sand of from four to five feet while there is only a small sheet.

2605. Ten square feet of sand with a depth of three feet will only filter seven hundred and twenty-three gallons every twenty-four hours?—That is the ordinary sand filter, but if you go to the American filters you will find a velocity of filtration of 120 metres a day, a little more than half of this two hundred cubic metres, and these filters are employed almost exclusively in America at present.

2606. So that you say you can get a sandstone that can filter forty-five thousand gallons a day?—Quite easily, per square metre of surface.

2607. And, therefore, your cube will filter six times that amount?—I have even calculated four hundred cubic metres.

2608. That is for your cube?—Yes.

2609. And that would be a rate of filtration something like ten times the filtration through ordinary filters such as those used here?—It would be more than that.

2610. You think then that your bore wells at the bottom of your dams would filter the water as fast as it came in?—Yes, the filtration is not the difficulty. The absorption is the difficulty. The filtration through these filters would certainly be as quick as possibly the absorption of the rock could be.

2611. What rock?—The bed rock of the dolomite.

2612. Yes, but that is not the point. That is not answering my question, because you guard yourself immediately by saying, well, if the dolomite will not take so many thousand gallons, it is not the fault of the filter. My point is, that your sandstone filter could not possibly pass the water through as fast as the dolomite could take it?—Oh, yes, it could.

2613. And I go on these figures. I go on the actual practical application of sandstone filters in the Kurka system and allow you double the rate of filtration which Kurka has?—That is not sufficient.

2614. And you think, therefore, you can increase the rate of filtration fast enough to take the water as fast as it comes into the pump?—Yes, at the rate of the whole quantity divided by 150 days.

2615. That is to say, if you had that equal rainfall, your filters would take it just as fast as it came in?—Yes.

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2616. We will now come to the dam itself. Your dams ought to be able to collect in any case a fourteen days' supply, should they not, at the rate of forty-seven million gallons per day?—Yes, but I have not calculated at fourteen days. I have only taken it at ten days.

2617. So that you think this, that if we had a three days' rain, and your dam was large enough to collect that rainfall in these three days, your filters would pass that quantity of water into the dolomite in ten days?—Yes.

2618. And your dams would be ready again to operate on the next rainfall?—Yes, but that is absolutely a technical question. I calculate on an area per day of fifty-five centimetres, that is less than two feet and there should be no difficulty in making a dam eight metres high.

2619. Take it this way, what would you reckon in million gallons would be the capacity of each of your dams? Have you not worked that out already?—You see, I had it worked out in metres; on eight days it should be about fifty million gallons.

2620. But I thought we had to pass forty-seven millions in a day?—Yes, but you know it is very difficult for me to calculate in gallons. The full filtration is fifty-five centimetres.

2621. Well, I shall put it in this way. Have you reckoned what each of these dams would cost with the bore wells and filters?—Yes, I have put the total here for the dams and wells and for the gallery at £600,000.

2622. For eight dams and bore wells?—Yes.

2623. In this £600,000 you put the gallery at £300,000?—Yes.

2624. That is £300,000 for eight dams with one thousand bore wells?—Yes, the bore wells are not very expensive.

2625. Do you know the Rosherville dam?—No.

2626. Have you never seen it?

(*The Acting Chairman.*) The big dam down here on the Natal Spruit.—I don't know it; but these dams I speak of are not to be built of masonry.

2627. (*Mr. Dumat.*) Do you know what that dam cost?—No.

2628. £100,000 for one dam.—Yes, but what length are the sides?

2629. It holds one thousand million gallons of water.—Yes, but this is on a steep slope, this dam you speak about.

2630. Oh no. Well I will pass on from that.—You see that dam is of masonry and these dams I speak of do not require to be of masonry. They do not need to be tight.

2631. I have got these figures here, fifteen days' rainfall collected at the rate of forty-seven million gallons per day.—It would be better that I took these figures down.

2632. Well, my figures are correct?—Will you let me take it down?

2633. Yes, 15 days' rainfall at the rate of 47,000,000 gallons per day would give you 705,000,000 gallons as the capacity of the dam and then in my simplicity I argue this that if the Rocheville dam which holds 1,000,000,000 gallons cost £100,000 it would be a very fair thing to say in favour of that scheme of yours that a dam which has to hold 705,000,000 gallons would cost £50,000, putting it at the lowest price and therefore eight dams would cost in themselves £400,000?—That is not necessary.

2634. Will you tell us whether you are personally acquainted with this Klip River Valley district?—Yes.

2635. You have seen it yourself?—Yes.

2636. Where do you intend putting your dams?—Oh, that is indicated in the photograph.* That is, of course, only approximate, and it will have to be determined after proper surveys.

2637. Naturally your dams would be so situated as to take advantage of the natural flow of water on the ground?—Yes.

2638. And therefore you propose putting your dams mostly on the upper part of the Klip River?—Yes.

2639. Where it flows from west to east?—Yes, but I have also dams up in the Natal Spruit basin.

2640. I know, but the majority of your dams are here?—Yes.

2641. And the dams are situated, some across the river bed and others across the streams which run into the river?—Yes.

2642. And you have two other dams right away to the east of the bend of the Klip River on the Natal Spruit?—Yes, on the Natal Spruit.

2643. These dams would drain an area of which the watershed is the Main Reef, Johannesburg?—Yes.

2644. And do your filters filter cyanide of potassium?—I recognise that difficulty perfectly, and pointed out in all my reports that if there is cyanide in it, the scheme cannot be carried out at all.

2645. You think it cannot be carried out?—Certainly not.

(*The Acting Chairman.*) That will do, Mr. Karlson, thank you. The Commission wish to express their thanks to you for the great trouble you have gone to in preparing all these documents for their information.

(*Mr. Lance.*) Mr. Chairman, I think Mr. Karlson will be prepared to give some little supplementary evidence on this question of cyanide, if it would be permitted.

(*The Acting Chairman.*) Who is to lead the evidence?

(*Mr. Lance.*) Mr. Karlson could put in a supplementary statement, and I could put a question or two.

* Not printed.

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Mr. A. Karlson. February 3, 1902.

(*The Acting Chairman.*) Just wait a moment, Mr. Lance, for Mr. Dumat.

(*Mr. Karlson resumed his seat in the witness-box.*)

2646. (*Mr. Lance.*) I should like to ask you, Mr. Karlson, whether this question of cyanide from the Witwatersrand would affect any other source of water supply than Klip River?—Yes, I consider it would affect every water supply, and I think it must be absolutely pointed out that the mines must find a system to separate the cyanide chemically from the water before the water is allowed to run into the stream.

2647. You say it will affect every system? Do you mean that the cyanide will get through into the dolomite?—Yes, most decidedly. I think that is all that is necessary for me to point out to the Commission.

(*The Acting Chairman.*) The Commission will adjourn until two o'clock.

The Commission adjourned for Luncheon.

ON RESUMING,

(*The Acting Chairman.*) We will hear Mr. Raubenheimer now.

Mr. HENRY JAMES RAUBENHEIMER (on behalf of the Riparian Owners on the farm Uitspanning), called and examined:

Mr. H. J. Raubenheimer. February 3, 1902.

2648. (*The Acting Chairman.*) You have put in a statement, Mr. Raubenheimer?—Yes.

2649. Would you please read it?—I have prepared my evidence, sir, in a written statement. I shall hand in a copy to the Commission.

2650. Will you read it now?—I have already handed in a copy of the late Mr. Blake's titles to the farm of Uitspanning. copy of the deed of transfer and copy of his diagram.

2651. Will you read out your statement?

The witness then read the following Statement:—

I have already handed to the Secretary copies of my client's titles showing the situation of the farm Uitspanning, from which it appears that he obtained transfer on the 27th November, 1897. Surveyor Kolbe's diagram of the farm shows how the Wonderfontein stream crosses the farm. I understand the Commission visited Wonderfontein at the end of last November and crossed at the Deep Drift. That Drift is situated on Uitspanning and the Commission will therefore have seen what a big volume of water there is.

In Law No. 11 of 1894 of the late South African Republic, we find a definition of a "Public Stream." Article 1 reads: "The term 'Public Stream' shall be taken to mean water flowing down in a defined channel, whether such channel shall contain water throughout the whole year, or shall be dry during any period." Article 3 also gives a definition of "Private Water." It reads: "The expression 'Private Water' shall be applicable only to cases where the fountain or stream is not permanent, or not capable of sub-division, or does not run in any defined course on to the farm of other persons."

I have been on the farms Wonderfontein, Uitspanning, and Welverdiend, and have seen the Wonderfontein stream thereon. I do not hesitate in saying that it complies in every respect with the definition of a "Public Stream," as laid down in the Article of the Law above cited, and that the owners of these farms are consequently riparian owners on the stream.

I take it that this will and must be admitted by every impartial person.

The question, What are the rights of riparian owners on a Public Stream? then naturally presents itself to us.

In the second half of Article 2 of the said Law we find a definition of such rights: it reads: "The owner of ground abutting on a public stream shall be entitled to use such water for household and agricultural purposes, provided he shall exercise his right in a reasonable manner."

Further on in the said Law we find it laid down in Article 10 that: "Water led or taken out of a public stream by means of water-furrows or otherwise, shall not be conducted beyond the limits of the farm on which it shall be taken out, and shall be returned to the public stream within the limits of such farm, unless the water so taken out shall have been used up in a reasonable manner, or the lower proprietor wishes to use the water for domestic and agricultural purposes, with the consent of the parties interested, in such wise that the water is not led in a wrong direction."

It may be argued that Mr. Goch has a Concession approved of by the Government to pump away water which would otherwise run waste into caves on the farm Wonderfontein, that the Law does not apply to such water, and that the owner can therefore do with it as he pleases. I do not think that this argument will hold good. In the leading case of Van Heerden *vs.* Wiese, decided on appeal in the Supreme Court of the Cape Colony, in June, 1890. Chief Justice, Sir Henry de Villiers, said: "When once the public nature of the river or stream is established, the rights of such riparian proprietor, whether at its source or along its course, are limited by the natural rights of the public, so far as those rights are capable of being exercised, and by the common rights of the remaining riparian proprietors." If Wonderfontein is admitted to be a public stream (as I contend it must be) the rights of the owners of the farm so named are limited as above defined, and

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they are debarred from using it, otherwise than as stated in the said Article 10 of Law No. 11 of 1894.

The validity of Mr. Goch's Concession will therefore no doubt be tested on these grounds, and the Government has been careful to protect all parties in Article 13 of the said Law No. 11 of 1894, which reads as follows: "Where any Concession shall already have been granted by the competent authorities for leading of water by means of any sort of construction, out of any public stream, beyond the bounds of any riparian property on which it was taken out, no provision contained in such Concession shall be construed as exempting the concessionaire or his assigns from the obligation of making good the damage occasioned by such Concession to any lower riparian owner, or to riparian owners on the other side of the stream."

It may also be argued that the rights of the lower owners are safeguarded under the said Concession which gives them the right to close all caves below the pumps. We do not consider this argument satisfactory since we contend that we have a common right to all the water on Wonderfontein, and that so soon as any portion thereof is pumped away our rights are affected and prejudiced.

In conclusion, I wish to add that I believe Wonderfontein to be the best source for a water supply for the Witwatersrand, but that to make it a success all the riparian owners on the stream must be embraced in the scheme.

(Sgd.) H. J. RAUBENHEIMER,
Solicitor for the Estate of the late Robert Blake, Jun.

Johannesburg,
3rd February, 1902.

2652. I think we had better let this statement stand over until Mr. Dumat has had an opportunity of going through it. We will postpone the cross-examination until after we have heard Mr. Schumacher.—Very well, sir.

2653. Have you given Mr. Dumat a copy of the statement?—I have a copy here which I can give to Mr. Dumat.

(*Mr. Dumat.*) I don't think I have any questions to put, Mr. Chairman, but I shall ask leave to call Mr. Goch later on with respect to the position of the farm owners whom Mr. Raubenheimer represents.

Mr. H. J. Raubenheimer.

February 3, 1902.

(*The Acting Chairman.*) When do you propose to do so?

(*Mr. Dumat.*) At the next sitting of the Commission. I am not prepared to enter into a discussion on the legal position of the riparian owners at present.

2654. (*The Acting Chairman to witness.*) I take it that is all you wish to state?—I presume the Commission is satisfied as regards the title and position of my client on the stream itself and my client's farm, and that the Commission is satisfied as to the validity of title.

2655. The Commission will not go into that.—I heard that the Commission were visiting Wonderfontein, and I saw the Secretary and told him it would be as well if the Commission could go down along the stream and satisfy themselves as to the position of the adjoining farms. I understand that the Commission crossed the big drift at Wonderfontein, which is on my client's ground, and if they did so, they will have seen my client's position.

2656. (*The Acting Chairman to Mr. Dumat*) You propose to put Mr. Goch into the witness box at the next sitting?

(*Mr. Dumat.*) I would like to.

2657. (*The Acting Chairman.*) You will send a statement of what evidence Mr. Goch is to give?

(*Mr. Dumat.*) Certainly.

2658. (*The Acting Chairman to Mr. Raubenheimer.*) You will then, Mr. Raubenheimer, have an opportunity of examining Mr. Goch.

(*Mr. Raubenheimer.*) Thank you. I was just going to ask that. The Secretary will inform me when Mr. Goch is to appear.

(*The Acting Chairman to Mr. Dumat.*) I think it would be better, perhaps, if the Commission had a statement as to what evidence you wished Mr. Goch to give, and we will then let you know whether we wish Mr. Goch's statement to be given.

(*Mr. Dumat.*) Yes. I assume, of course, that, if on more mature consideration, Mr. Goch need not be called, it would be sufficient if I informed the Secretary of the Commission to-morrow.

(*The Acting Chairman.*) Yes.

THE VIERFONTEIN SYNDICATE, LIMITED.

Mr. R. N. SCHUMACHER, called and examined:

2659. (*The Acting Chairman.*) Mr. Schumacher, you have handed in a statement to the Secretary?—Yes. Shall I just state that I am a director of the Vierfontein Syndicate, and also a director of several gold mining companies on these fields.

Mr. R. N. Schumacher.

February 3, 1902.

2660. The witness then read the following statement:—

JOHANNESBURG,
January 28th, 1902.

It has been intimated to the Directors of the Vierfontein Syndicate, Limited, that there was a wish on the part of this Government Water Commission to have placed before it some facts about the Syndicate, as to who were connected with it, what it had done in the past, and what it intended to do in the future. It was known that the Vierfontein Syndicate had powerful firms behind it, that it has taken steps to secure various water supplies for many of the Witwatersrand Gold Mines, and that it intends to extend its operations in the future; but I think that I am right in stating that, as far as the Commission and the outside world are concerned, nothing definite about the Vierfontein Syndicate is known.

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Mr. R. N. Schumacher.

February 3, 1902.

The Vierfontein Syndicate, Limited, is perfectly willing to lay before the Commission the broad outlines of the work that it has done, and it comes forward with the intention of assisting the Water Commission, as far as lies in its power, towards a satisfactory solution of the water question.

I will now give a short account of the operations of the Syndicate:—

The Vierfontein Syndicate, Limited, was registered in March, 1893, with the object of acquiring and exploring for mining water supplies and other purposes a certain portion of the farm Vierfontein No. 130, situated in the District of Heidelberg in the then South African Republic. The early records of the Syndicate are of no real interest to the Commission.

Little actual work was done, and the Working Capital was absorbed in making various tests and in considering different schemes that ultimately led to no final issue.

In the month of August, 1898, the shares of the Vierfontein Syndicate had gradually been consolidated into the hands of three leading Mining Firms, viz.: Messrs. H. Eckstein & Co., The Consolidated Gold Fields of South Africa, Limited, and Messrs. S. Neumann & Co. These firms then combined and handed over to the Syndicate certain preparatory work which had already been undertaken by them individually. The engineers of these firms had already in 1898 gone carefully into the question of Water Supply for the Mines in the future, and I append a table of figures* prepared at the time by the late Major L. I. Seymour showing that, whereas the rainfall was fairly constant (in the neighbourhood of 30 inches per annum) the number of stamps was increasing year by year with startling rapidity—from 711 in 1889 to 4,767 in 1898, and to 6,000 in September, 1899. The tonnage milled had increased from 316,163 tons in 1889 to 7,331,446 tons in 1898; and the tonnage crushed in 1898 was more than double that of 1895.

Major Seymour also made the following estimate as regards the probable increase of stamping power after five years had elapsed from 1898 in connection with mines controlled by the four Groups; *i.e.*, Messrs. H. Eckstein & Co., The Consolidated Gold Fields of South Africa, Limited, Messrs. S. Neumann & Co., and Messrs. Farrar Brothers:—

	No. of Stamps.
On the Mines in operation in 1898, between the Paarl Central and Modderfontein Extension, inclusive	3,230
Increase in Stamps on the above Mines up to 1903.....	1,000
On new Mines floated into Companies, but not yet milling.....	2,860
On mines proposed to be exploited shortly, most of which are expected to be crushing by 1903; ultimate milling capacity.....	4,550
	11,640

* See Appendix J. 1.

I append an extract* from a letter dated the 23rd March, 1899, written by Major L. I. Seymour, in which he estimates that the 8,400 fresh stamps under the control of the above-mentioned Groups would ultimately require an additional supply of 16,800,000 gallons of water daily.

In view of the low state of the Reservoirs in 1898, and of the absence of heavy rains, it was decided by the Directors of the Vierfontein Syndicate, Limited, that work should be pushed ahead with all speed, and that the Groups represented by the Syndicate should, in the meanwhile, bear all preliminary expenditure. The intention of the Groups was to make no profits out of their operations in connection with the Water Supply, but to work solely in the interests of the Mines with which they were connected, and it was an understood thing that the Mines would be approached at a later stage, when the scheme was more mature, with a view to taking over the whole position at cost price. I wish to lay stress upon this point, because it means that, in dealing with the Vierfontein Syndicate, Limited, one has to deal with virtually all the Mines that are connected with the above-mentioned Groups, which, as I have pointed out already, were in 1898 running 3,230 Stamps out of the total of 4,767 Stamps—or rather more than two-thirds, and were therefore crushing rather more than two-thirds of the tonnage treated on the Witwatersrand Gold Fields.

One of the first steps taken by the Vierfontein Syndicate, Limited, was to engage the services of Mr. H. Hall, who has been State Engineer in California, where he had also constructed some very important dam walls. On his advice, it was decided to build a dam wall between the neck of the two hills situated on the farm Rietvlei—immediately south of the Eastern portion of the farm Vierfontein, which has since been re-named "Ormonde." The necessary site on the farm Rietvlei had been acquired by the Vierfontein Syndicate, Limited, and it was expected that a wall ninety feet high would create a reservoir having a maximum capacity of nearly 1,000,000,000 gallons. Work was prosecuted with vigour, but was discontinued later in 1899, as from the experience of the rainy season of 1898, there were no hopes of obtaining any large supply in one year; and it was, therefore, deemed advisable to concentrate operations on the dolomite formation south of the line of reef, on which the Vierfontein Syndicate had acquired important areas. It is not necessary for me to go into long details about the dolomite formation that exists in the neighbourhood of the Witwatersrand Gold Fields; the question has already been dealt with at great length by various engineers who have given evidence before this Commission, and there is no doubt but that there is a large supply of water in this formation, and that the water is thoroughly suitable for drinking and mining purposes.

* See Appendix J. 2.

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Mr. R. N. Schumacher.

February 3, 1902.

At the beginning of 1899 it became apparent that, while the Vierfontein Syndicate must obtain all the information possible with regard to the best and most reliable sources of supply for a final and permanent scheme, it must take steps in the meanwhile to meet any immediate shortfall that might occur during the next dry season, as the permanent scheme would necessarily take time—perhaps a year or so for the preliminary enquiries and investigation, and then a further three or four years for the erection of plant and other equipment. Consequently it was deemed advisable to secure the services of Mr. Thomas Stewart, as this gentleman, besides having wide general experience, had also the most thorough knowledge concerning the various sources of supply in the neighbourhood of Johannesburg. Mr. Stewart was then asked to make two reports: one on the work that should be taken in hand in order to meet the most pressing requirements of the near future; the other to deal with all the feasible sources of water supply within a fifty mile radius of Johannesburg.

I will, later on, touch lightly on the general permanent scheme, and deal now with the scheme taken in hand to meet the immediate requirements—which we called the temporary scheme.

Apart from the dam wall on Rietvlei, to which I have already referred, a good deal of prospecting work was carried on upon the farm Oliphant's Vlei and Rooikop, as well as, though to a lesser extent, on Misgund and Zwaartkoppies.

Dealing first with the work at Oliphant's Vlei, it was resolved, after certain tentative boring and shaft-sinking, to put down a permanent circular shaft, 16 feet in diameter, which was eventually sunk to a depth of nearly 100 feet in the dolomite formation. A considerable inflow of water was encountered, about 400,000 gallons per day, and it was anticipated that on arriving at a further depth of about 40 feet, which would be the bottom of a large cavern that had been proved to exist by a borehole, the inflow of water would be very largely increased, as a trial shaft close by had yielded over 750,000 gallons per twenty-four hours.

I append estimates* of cost which show that, for an expenditure of £166,000 it would be possible to deal with a daily supply of 2,500,000 gallons of water from the caverns of Oliphant's Vlei and Misgund, while the ten miles of 28 inch pipe line from the Central Station to the Receiving Reservoir and thence to the Rand Mines' System would be capable of dealing economically with further 7,000,000 gallons of water to be provided later on from other sources.

The works at Oliphant's Vlei were pushed ahead, and pumping to the mines commenced in the month of August, 1899. From figures which I append† it will be seen that 3,548,600 gallons were pumped during the last days of August, and 10,041,600 gallons during September. The average pumping for the whole of the month of September was, therefore, at the rate of slightly over 330,000 gallons per day.

At Rooikop, which is in a different catchment basin to Oliphant's Vlei, a shaft was sunk, after certain preliminary work, to a depth of 43 feet, and struck an inflow of water of 423,000 gallons per day, which was pumped without affecting in any way a spring in the immediate neighbourhood.

At Misgund little work has been done, and the information acquired is insufficient to enable us to form any definite ideas as to the supply of water that can be expected. Mr. E. H. V. Melville is most anxious that trial shafts should be sunk on this farm.

Mr. Thomas Stewart, in a report, dated June, 1900, states that neither Oliphant's Vlei nor Rooikop had been subjected to exhaustive tests, and that he considered that the indication at both places shows clearly that more water could be obtained by sinking the shafts deeper.

The Syndicate also owns virtually the whole of the large and very important farm Zwaartkoppies, No. 262, district Heidelberg, about which the highest opinions are held, and which is regarded as an asset of the greatest value.

We have in our possession estimates made by Mr. Stewart of the expenditure required to deal with the daily yield from Rooikop, which is taken at 1,000,000 gallons per day, and also 2,000,000 gallons daily which is the minimum yield confidently expected from Oliphant's Vlei and Zwaartkoppies.

One can say, therefore, that towards the end of 1899 the Vierfontein Syndicate had its hand upon a daily supply of 3,000,000 gallons from the dolomite formation, while there was every expectation of exposing a considerably increased supply as soon as prospecting could be carried on upon a larger scale.

I must make it quite clear that the three groups interested in the Vierfontein Syndicate, Limited, had in 1899 other sources besides the dolomite formation at their immediate disposal, as it had been agreed to pool the water from the following reservoirs and shafts:—The Natal Spruit Reservoir, the Booysen's Reservoir, Knight's Deep Shaft, Robinson Central Deep Shaft, Village Deep Shaft, Simmer East Shaft, and I append a table* showing the amounts of water drawn from these various sources during the twelve months from October, 1898, to September, 1899. It will be seen that during September, 1899, 81,998,500 gallons altogether were pumped from these sources, and I may point out that

* See Appendix J. 3.

† See Appendix J. 4.

* See Appendix J. 4.

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Mr. R. N. Schumacher. February 3 1902.

it was deemed advisable at that time to draw as little water as possible from the open reservoirs, that were to be kept as a standby, and to concentrate efforts rather on pumping from the shafts, for the big reservoirs were then abnormally low.

In September, 1899, the Natal Spruit Reservoir, belonging to the Rand Mines, Limited, which has a total capacity of 973,000,000 gallons, contained only 40,000,000 gallons. To-day it contains 820,000,000 gallons.

The Booysen's Reservoir, also belonging to the Rand Mines, Limited, which has a total capacity of 237,000,000 gallons, then contained 25,000,000 gallons. To-day it is full.

On the 21st August, 1899, the Syndicate considered itself to be in a position to ask the mining companies between the Paarl Central and the East Rand Proprietary Mines, a distance of approximately twenty miles, whether they wished to join a temporary water supply scheme that would probably be able to tide them over for a couple of years, by which time it was hoped that a permanent scheme would be well in hand. I enclose a copy* of a circular that was sent out by the Vierfontein Syndicate at the time, and would call attention to the fact that every single mine in the above area was approached—and not only the properties connected with the four big groups already referred to—because it was the wish of the Vierfontein Syndicate to give every mine, irrespective of with whom the control lay, the opportunity of becoming identified with this temporary water supply scheme that was intended to be the forerunner of something bigger. It will be seen from the circular that the companies would, in the first place, have to pay a fee of £10 per stamp in order to become entitled to the proportion of the available supply of water, and that the charge proposed was to be at the rate of the actual cost of delivery, plus sixpence (6d.) per 1,000 gallons. The then cost of delivery was estimated, and was to be charged for, at 2s. per 1,000 gallons, the Syndicate having the right to reduce or raise the price as circumstances might require, but in no case above the rate of 4s. per 1,000 gallons. Clause 4 of the circular states:—

> "The amount of £10 per stamp is estimated to cover the actual cost of the Temporary Works, and is by no means a source of profit to this Syndicate. Our Directors, therefore, beg to point out that in justice to such working Companies as may now agree to our proposal, it will not be possible at a later date prior to the establishment of the Permanent Scheme to admit other Companies to share in the advantages now offered."

* See Appendix J. 5.

Of the Mines approached, the following agreed to participate:—

Name of Company.	No. of Stamps.	Payment to the Vierfontein Syndicate at the rate of £10 per Stamp.
		£
Crown Deep, Ltd. ...	200	2,000
Langlaagte Deep, Ltd. ...	100	1,000
Bonanza, Ltd.	40	400
Ferreira Deep, Ltd. ...	160	1,600
Robinson Deep, Ltd. ...	120	1,200
Wemmer G.M. Co., Ltd.	50	500
Salisbury G.M. Co., Ltd.	50	500
Jubilee Gold Mines, Ltd.	50	500
Village Main Reef G.M. Co.	100	1,000
City & Suburban G.M. Co.	160	1,600
Wolhuter G.M. Co., Ltd.	100	1,000
Henry Nourse G.M. Co., Ld.	80	800
Nourse Deep, Ltd.	100	1,000
New Heriot G.M. Co., Ltd.	70	700
Jumpers Deep, Ltd. ...	100	1,000
Treasury Gold Mines, Ltd.	50	500
Geldenhuis Deep, Ltd. ...	200	2,000
Rose Deep, Ltd.	200	2,000
Glen Deep, Ltd.	100	1,000
Witwatersrand G.M. Co.	120	1,200
Driefontein Cons. G.M. Co.	110	1,100
Angelo Gold Mines, Ltd.	110	1,100
Comet G.M. Co., Ltd. ...	100	1,000
Total (23 Companies)...	2,470	24,700

Special permission was also granted to the Paarl Central G.M. Co., Ltd., Crown Reef G.M. Co., Ltd., Robinson G.M. Co., Ltd., Worcester G.M. Co., Ltd., Ferreira G.M. Co., Ltd., and the Simmer and Jack Proprietary Mines, Ltd., to join the Syndicate later, also on bed-rock terms, because these Mines had already gone to considerable expenditure towards ensuring their water supply for the immediate future, and their Directors were anxious to avoid further expense if possible.

From only three mines in the District mentioned no answer was received by the Vierfontein Syndicate, Limited.

Having dealt with our temporary Supply Scheme, I will now touch lightly on the Permanent Scheme, which, as I have already observed, was intended to absorb the Temporary Scheme later on.

We have had a very thorough report by Mr. Thomas Stewart on all the available and desirable sources of water supply within a radius of 50 miles of Johannesburg, and during the last years we have had the most careful daily gaugings taken of the Klip and Vaal Rivers by Mr Laschinger, who has stuck to his post under conditions of considerable difficulty and danger. These statistics, extending over a long period of time as they do, are of the greatest value. but I do not propose now to go into details, as most of our information is of a private nature.

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The financial position of the Vierfontein Syndicate, Limited, to-day shows that it has expended the sum of £340,479 per 31st December, 1901, for the assets that are named in the enclosure* where full details are given, and the important group of mines that would be willing to participate in the further work of the Vierfontein Syndicate, Limited, are in the strong position of being insured against drought for some considerable time.

I may add that, if the Government should desire to supply the mines with water, the latter will be anxious to give assistance; but, naturally, having spent so much money on the acquisition of rights for themselves the Mines of the Central and Eastern Districts will be anxious to exploit these rights to the utmost, and they would probably, therefore, be willing to take from the Government only the deficiency of water that may be experienced, which will not be great until the expansion of the gold mining industry begins to take place.

(Signed) R. N. SCHUMACHER.

2661. (*Mr. Lance*, representing the Johannesburg Town Council.) There are just one or two points in your statement that do not appear quite clear, Mr. Schumacher. You refer to discontinuance of the dam on the Rietvlei?—Yes.

2662. What is given as a reason seems hardly to meet the case, does it? Was there not any other reason that you can mention?—Do you mean that I do not give you actually the real reason?

2663. I don't mean to say that, but it seems to me that saying it could not obtain any large supply of water in one single year was hardly a reason for discontinuing so large a work?—The point was really this: It was decided in 1897 and 1898 to build this dam wall as there was an expectation that it would be filled by the rains. Engineers, the expert engineers, reported to us to the effect that during the rainy season of 1898, while we were actually working, the well alongside the shaft was very unsatisfactory, and I believe all the rain actually caught was about four million gallons, and then, as it was urgent to obtain some source of supply as quickly as possible, we thought, as I have said here, that it would be well for the time being to abandon the work there and centre all our efforts on the dolomite formation, on which we had already been doing a certain amount of tentative work. That is the reason exactly, just as I have stated here.

2664. Then it was only temporary abandonment with a view to going on with the work later on?—The idea is discussed in various reports of continuing the dam later and using it as a storage reservoir. Originally the idea of the Vierfontein Syndicate in the old days was to build a dam wall there and to use it in connection with the Klip River lower down.

2665. You were to use it as a storage reservoir?—Yes.

2666. Then it was not intended as a reservoir to fill itself from a large catchment area?—It was at first hoped it would do so, but we found there was no prospect at all of its filling for a very long time.

2667. It was not that there was any technical engineering reason for abandoning the dam?—No. I might, just as regards the technical engineering question, say we had great troubles in the foundation, but they were got over. It cost us a bit of money, but there is nothing serious to anticipate there.

2668. You speak of the cost of pumping the water as being 2s. per thousand gallons?—No, I say the estimated cost.

2669. Were they not based on what you found to be the actual cost in pumping?—It states "it was estimated."

2670. Do you find those figures turn out to be your actual cost of pumping? You were pumping pretty largely in August and September, were you not?—No, we found the figure was pretty low. Our actual costs, without allowing for depreciation or any head office charges, the actual cost at the works themselves, varied between 2s. 9d. and 2s., diminishing slightly as we pumped a larger quantity.

2671. Yes, that is what I was coming to. This cost would diminish very greatly if the amount pumped were increased?—Well, I don't know that you can expect any very great decrease, because you must remember this does not, as I have said, include head office charges, engineering fees, depreciation or maintenance.

2672. (*The Acting Chairman.*) Did it include interest?—Nor interest. These are the actual costs at the works. I have here a letter written by Major Seymour in 1899, in which he makes a rough estimate of what it would cost to pump 3,000,000 gallons, *i.e.*, allowing for interest at the rate of 5 per cent. and maintenance but not including any cost of acquiring ground, 2s. per 1000 gallons. That is of course on a quantity of 3,000,000 gallons; on a quantity of 4,000,000 gallons the estimate is 1s. 9d. per 1,000 gallons. This includes everything except redemption of debentures, which, under his scheme, would have been issued. I think you must abandon any idea of getting your water here for 6d. or 7d. as has been stated by some of your witnesses. At all events these figures do not agree with any of ours.

2673. (*Mr. Lance.*) The distance of the work was about ten miles approximately?—Yes.

2674. Was it in one lift?—Yes.

2675. Can you give us what the lift was?—The elevation of the pumping station at Oliphant's Vlei is 5,060 feet.

2676. Then it is not much in the way of a lift?—No.

* See Appendix J. 6.

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2677. Would not these figures, if you came into a matter of seven to ten million gallons per day, be very considerably reduced?—Well, that is so to a certain extent, but all in, I think, you cannot reckon on much under 1s. 9d. per thousand gallons.

2678. In your statement you say you estimate to get a quantity of about two million gallons daily?—Yes.

2679. But you don't give us any data for these figures. You seem to have dealt so far with only about 300,000?—I give you the data at Oliphant's Vlei, where we had an inflow of 400,000 gallons, and that a trial shaft, which was quite close by, had yielded 750,000 gallons.

2680. Yes, but that does not, of course, make up 2,000,000 gallons?—No, we did not expect more than one million from Oliphant's Vlei.

2681. And you had no actual data to go on in forming this estimate?—We had the 750,000 gallons from the trial shaft. Our permanent shaft had not, we thought, reached the big channel. It had not connected yet.

2682. It was the opinion of your engineers, when you reached the big channel, you would get at least two million gallons?—One million from Oliphant's Vlei.

2683. Yes, one million from Oliphant's Vlei.—We reckoned roughly on not getting less than three million gallons from Oliphant's Vlei, Misgund, Rooikop, and Zwartkoppies, but, of course, we have done very little prospecting work on many of these farms, and there is no reason why it should not be possible for us to obtain a large supply.

2684. Then you speak later on of producing from these and other sources a total of seven millions, or rather providing a pipe to carry seven millions?—Yes, we have the pipe.

2685. What are the other sources?—Oh, the other water would come from a larger scheme that would have to be taken in hand later on.

2686. A scheme you had not gone into yet?—No, we had not.

2687. Was that from the dolomite formation?—Not necessarily, We were quite open in our minds. We were going to use the site at Oliphant's Vlei for building a receiving reservoir to hold about five million gallons, and it was our intention to pump into the reservoir from whatever source we might go to.

2688. I see, but you had not fixed any source?—No.

2689. You had simply provided this pipe to meet future contingencies?—Yes, we knew we should require a large pipe for use later, and got it out at once. We have these ten miles of 28 in. piping here.

2690. You did not reckon to include or mix with this water any of the water referred to in your other sources, such as the Natal Spruit dam?—Oh, no. We would not pump water down to there and then back again.

2691. No. You reckoned to use them separately here?—Yes, they were for distributing along the line of the reef.

2692. What I want to get at is, these sources of water supply would not be fit for drinking purposes at all?—I really don't know, I can't answer. I should think it would be better not to use them.

2693. They are surface water?—Yes.

2694. And I suppose there is a certain amount of cyanide in it?—Well I don't think that need be feared.

2695. No, but it might be. Do you think there is any possibility of cyanide finding its way into the dolomite water?—You want me to give my opinion?

2696. Yes, if you are able to form one.—I personally should not be afraid of that. I don't see why we should.

2697. Did you hear what was said this morning?—No, I went away.

2698. You don't think it would find its way in?—No.

2699. I have just one question more. I don't know whether you feel at liberty to answer or not, but I might as well suggest it, as to whether your syndicate would be prepared to come into any general scheme for the supply of the Rand?—I think it depends greatly on by whom the general scheme was taken in hand. We should, as stated in my report, be most anxious to assist the Government.

2700. Yes, and if the Government took up a general scheme to supply the mines and the towns you might be prepared to come in?—I should think we would be very pleased to assist the Government in any way that we could.

2701. (*The Acting Chairman.*) Are you in a position to state whether there are any figures you can give us as to what would be the cost of acquiring the assets of the Vierfontein Syndicate? Are you prepared to say?—The matter has not come before the Board at all. It has not been discussed by the Directors, but I think they would be very willing to meet the Government and take the actual cost price.

2702. Would the Vierfontein Syndicate be in a position now to deal with the Government without reference to any of the mines?—Yes, at present the position is that the mines have not been approached with regard to coming into the permanent scheme. Of course it would have to be understood any liabilities existing towards the companies in connection with the temporary scheme would have to be taken over by the Government.

2703. That is, the obligation of supplying water?—There is no direct obligation, but there is a moral obligation to assist them in time of need as far as possible.

2704. But there is no guarantee of the supply?—No, there is no written guarantee at all. There is only the moral understanding that the Syndicate will help the mines in times of stress as far as it can.

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2705. Then you have referred to some reports by Mr. Stewart, which are very thorough, and comprise reports on the sources of supply round Johannesburg within a fifty mile radius. You say these are of a private nature, and, therefore, I suppose the Syndicate does not care about placing them at the disposal of the Commission?—I don't think the Syndicate would like them to be made public, but if the Government is anxious to see the papers we might meet them.

2706. And then also there are gaugings by Mr. Laschinger of the Vaal River. I think they perhaps would be of very great use to the Commission?—Well, they are very valuable figures.

2707. Of course I am only asking, that perhaps you would be prepared to communicate with the Government in regard to them?—I am speaking without the authority of the Board, but, I think, if the matter were to be put before the Board, the Directors would be willing to give all these figures, provided it is really a question of coming to terms.

2708. (*Mr. Kitzinger.*) I only want to ask you in regard to the number of stamps given in the late Mr. Seymour's letter. There is a considerable difference between these and the statement of the Chamber of Mines?—Yes, but the Chamber of Mines deal with the whole of the Witwatersrand. Mr. Seymour deals only with those under the control of the four groups I have mentioned, Messrs. Eckstein & Co., the Consolidated Goldfields, Messrs. Neumann & Co., and Messrs. Farrar Brothers.

2709. There is another point I should like to ask you, but I think the figures are prepared on similar lines, on the same basis, viz., the water used?—Yes.

2710. You refer in one part of your report to the stamps in operation in 1903, and you put in brackets, "which would now be 1908"?—Yes, those figures were prepared in 1898, and five years from 1898 would come to 1903, but, as the war has intervened and we are not yet in normal running order, I start from 1903.

2711. Do you add on five years for the delay of this war?—You see in 1898 the mines were in full running order and we reckoned it would take them five years to increase their stamps as I have pointed out. Now we are not in full running order, but I assume we will be in about a year's time, say 1903, so I take five years from then.

2712. (*Mr. McCallum.*) In one part of your report you speak about a bore-hole having struck a cavern about forty feet deep. Can you tell us whether you struck any other caverns?—With that bore-hole?

2713. No, with any?—The whole ground is full of caverns. If you drive over there, you hear the rumbling in many places.

2714. You are quite a believer in this dolomite holding a lot of water?—You must not tack on any expressions to me, but the caverns do exist.

2715. The farm Zwaartkoppies, is that beyond the Klip River?—The farm Zwaartkoppies is to the east of the farm adjoining Allewyn's Poort, and is south of Rietvlei, which in turn is south of Turffontein. Mr. R. N. Schumacher. February 3, 1902.

2716. Have you proved the dolomite formation down as far as that?—A certain amount of prospecting work has been done there and the formation of the ground is exactly similar in parts to that of the dolomite formation in already proved districts. I think there is no doubt whatever in the minds of the engineers on that point, and we have done a certain amount of work which has proved it.

2717. (*Mr. Brakhan.*) You give us in your statement the number of stamps at work in September, 1899, at about 6,000?—Yes.

2718. You also say that in 1898, out of a total of 4,767 stamps, 3,230 were at work controlled by the four groups you mention. Can you give me the figures as they compared in 1899?—No, I have not got them but there is every reason to expect that they are in exactly the same *ratio*, with no appreciable difference at all events.

2719. Would it be right to say that the four groups controlled 3360, and the other groups 2670?—You want to change my proportion.

2720. Oh, no, I only want to bring out the proportion as it existed in September, 1899. You give the figures at 6,000 stamps and then you give the proportion for the year 1898. From 1898 to 1899 considerable extension had taken place?—Yes, but I think it took place just as much in the mines connected with these firms as in the mines not connected with them. There is no reason for considering that there would be any appreciable difference.

2721. I have figures showing it was 3360 as compared with 2670?—These figures I am quoting from Mr. Seymour's letter, and the 6,000 in September, 1899, is added in parenthesis, because his letter is dated March, 1898.

2722. As regards the supply to the mines along the Reef from Paarl Central to Boksburg, there were certain mines which did not join because they had an arrangement with the Johannesburg Water Company?—A certain number of mines had contracts running, and were being supplied by the Johannesburg Waterworks, and therefore in any scheme even for that area a large outside demand would have to be provided for. I don't personally know of any mines that had contracts here.

2723. Not those connected with any other group?—But I said only three gave no answer. I have knowledge of one mine that has been drawing water lately from the Waterworks Company, but they have been charged a rate in excess of what would be charged by the Vierfontein Syndicate, so I don't think they would use the Waterworks as anything more than a standby except for drinking purposes. It is very probable

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they draw from the Waterworks Company for that because much of the water pumped for the mines cannot be relied on for that purpose.

2724. There are contracts existing betwen the Primrose, Glencairn, May Consolidated and Geldenhuis and the Waterworks, but they had favourable terms under which they had been drawing drinking water and also for the mills?—I have given a list of the mines that replied to the circular of the Syndicate, and I think it fair to take those, together with any new ones belonging to the same groups, and say that they would join the Vierfontein Syndicate, whilst any other mines are doubtful. I don't pretend to say that any of those mines will come in. I don't want to give the impression at all.

2725. In other words the point is this, that there are certain other mines who have requirements. I do not speak of the Vierfontein Syndicate — There are a certain number that have not joined. The others don't interest us any more now.

2726. Of course as regards the Commission it would be interesting to know how big the demand is outside of that list?—Yes.

2727. Now, in regard to Rooikop, I gather there is already a pipe laid down?—No, there is not.

2728. I understood that in your statement it is stated that a certain inflow of water of 423,000 gallons per day had been pumped from a shaft without affecting in any way the spring in the immediate neighbourhood?—Yes, it was pumped away, but we did not actually pump it to any of the mines.

2729. Therefore only water from Oliphant's Vlei had been conveyed and pumped to the Reef?—Yes. We have already located a proposed reservoir in the neighbourhood of the Rand Victoria Pan, but no pipe line has actually been laid. At that time we were largely using the water from the Knight's Deep shaft. If you notice, from these figures included in my statement, during the last months of August and September, 1899, as much as forty million gallons were being pumped per month from the Knight's Deep shaft.

2730. This water from Rooikop was merely pumped from the spring or well a little distance away, in order to see whether it would have any effect on the supply?—Yes, we only had our shaft down 43 feet, so that there was nothing conclusive except that there was at the time a minimum supply of 453,000 gallons per day.

2731. (*Mr. Quinn.*) The Chamber of Mines, in their statement before the Commission, estimated the future requirements at 20,000,000 gallons per day for the mines. I understand from the statement put in by you this afternoon that the Vierfontein Syndicate has never had more than one million gallons per day from their present sources of supply?—No, that is not quite correct. We have never actually pumped more than 400,000 gallons per day from the shaft at Oliphant's Vlei.

2732. But you estimate a total quantity of 2,500,000 gallons per day from your present sources of supply?—No, we reckon we ought to get in the neighbourhood of 3,000,000 a day from our present supplies in the dolomite formation and there is the chance of getting more.

2733. Taking these outside figures of three millions——?—No, I don't want you to look upon them as outside figures, Mr. Quinn.

2734. Well, then, I would like to know what is the greatest quantity of water per day you have actually pumped?—We have actually never pumped to the Mines except from Oliphant's Vlei.

2735. You have reasonable hopes of expecting three millions, is that the way you wish to put it?—We have reason for expecting that we shall get three millions, based on the prospecting work already done.

2736. Quite so, but a good deal of that is conjecture. There is nothing certain about the three million gallons?—I can only say that it is Mr. Stewart's conjecture and we find him very conservative in his estimates, far more so than many engineers.

2737. Well, we will take it for granted that three millions can be found. That still leaves seventeen million gallons, according to the estimate of the Chamber of Mines, and, I take it from your answers to the members of the Commission, that with regard to that seventeen millions, you have nothing in your mind's eye. I want to know now what justifies your estimate of obtaining seven million gallons per day?—That is to come from some other source of supply altogether, either from the dolomite or rivers.

2738. The supply has yet to be found?—Yes.

2739. It comes to this, that we have seventeen million gallons per day to provide for from somewhere?—Yes.

[End of Evidence.]

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APPENDIX OF DOCUMENTS.

A.—Opinion of Legal Adviser on questions arising out of Wonderfontein Concession.

B.—Report of Government Committee on Water Supply for Johannesburg in 1895.

C.—Letters from Resident Magistrates at Boksburg and Krugersdorp with regard to population of those places.

D.—Documents referred to by Mr. G. H. Goch in his evidence on behalf of the Wonderfontein Concession.

E.—Memorandum on Vaal River Scheme.

F.—Documents referred to by Mr. G. B. Andrews in his evidence on behalf of the Johannesburg Town Council.

G.—Documents referred to by Mr. Thomas Stewart and Mr. Thomas Raynes in their evidence on behalf of the Johannesburg Waterworks, Estate and Exploration Company.

H.—Memoranda by Mr. Karlson, City Engineer, Pretoria.

J.—Documents referred to by Mr. Schumacher in his evidence on behalf of the Vierfontein Syndicate.

K.—Statement with regard to the Vaal River Scheme by Mr. J. N. de Jongh, on behalf of the Vereeniging Estates Company.

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Appendix A.

Legal Adviser.

APPENDIX A.

Opinion of the Legal Adviser to the Administration on certain questions arising out of the Wonderfontein Concession. (Referred to in the Report.)

LEGAL ADVISER,—

The Water Commission are anxious to have a legal opinion on two points, and I have undertaken to ask if you would be good enough to advise us.

The questions are:—

(*a*) The Wonderfontein Concession, clause 1 (*a*) (p. 290 of the Concessions Commission Report, Part III.) gives the Concessionaires (the joint owners of the farm Wonderfontein) the right to take up to one-fourth of the water on the farm, for the purpose of a water supply for Johannesburg.

By clause 1 (*b*) the Government "undertakes to grant to no other person or persons, Company or Companies, the right to take the water from the Wonderfontein stream to the ground to the N.E., within the following lines....."

Assuming the Concession to be valid and to be recognised by His Majesty's Government, is there anything in the undertaking just quoted which would prevent the Government from (*a*) itself or (*b*) through a Public Board constituted by it for that purpose, making use of the other three-fourths of the water for supplying the Rand with water under a scheme of its own to which Mr. Goch (the present holder of the Concession) would not be a party.

(*b*) I annex a Memorandum by Mr. Karlson on Underground Water Rights.* Your opinion is asked on the following points:—

1. Under the present law of this country, if A has a spring rising on his farm, can B, on his own farm, lawfully intercept the water on its underground passage to A?
2. Is B's position the same in the two cases of the water (*a*) percolating underground, (*b*) running in a recognisable channel underground?
3. Is B, in either or both cases legally liable to compensate A?
4. The Wonderfontein Stream rises as a spring on farm C, and after flowing a short distance disappears into the ground. Mr. Goch contends that it is then lost; local people contend that it rises again some miles beyond, forming the principal source of the Mooi River. If Mr. Goch diverted one-fourth of the water from the spring, or on the farm, by leading it away to Johannesburg, would an action lie against him on the part of riparian owners on the Mooi (or, *e.g.*, the Town Authorities of Potchefstroom which derives its water supply from the Mooi),
   (*a*) if there were a proved diminution of the flow of the Mooi, or
   (*b*) if without evidence of specific damage, the underground connection of the stream and the Mooi were proved?

(Signed) G. V. FIDDES,
(Chairman of the Water Commission.)

10th February, 1902.

LEGAL ADVISER'S OFFICE,
PRETORIA, 26th February, 1902.

To the Chairman of the Water Commission,—

I am in receipt of your Minute of the 10th February submitting for my opinion several questions arising out of the Wonderfontein Concession.

I think it will be more convenient for me to deal with the points raised by you in sub-sections 1, 2, 3 and 4 of (*b*) in your Minute before I give my opinion on (*a*).

The following principles are well established under the Roman-Dutch Law in force in this Colony:

1. A person on whose land water rises is not entitled to the exclusive use and enjoyment of that water if for the period of prescription (30 years) such water has been allowed to flow down beyond his land in a known and defined channel and has been for that period used by the lower proprietors. It matters not whether the defined channel be on the surface or underground.

* Not printed.

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2. No action lies against a person who by operations on his own land intercepts underground water finding its way by percolation to a public stream or to some well or fountain.

Guided by these two principles there is no difficulty in answering your questions 1, 2, 3, and 4 (B) as follows:—

1, 2, and 3. B can lawfully intercept the water on its underground passage to A if that water does not flow in a defined channel but reaches A by percolation. If, however, the water flows in a defined channel to A, B cannot by any operations on his own land deprive A of the rights of a riparian proprietor to that water. If he does it is an unlawful act on his part and an action for damages will lie against him by A.

4. If the water reaches the Mooi River by a defined channel and the supply of water to the river thereby is sensibly diminished by Goch diverting it where it rises on his land to Johannesburg the riparian proprietors on that river would have an action against Goch to prevent him diverting the water in that manner unless, of course, Goch is protected by his Concession.

I can find no evidence in the records of the proceedings of the Concessions Commission shewing that the original Concession to the owners of Wonderfontein was ever confirmed by a distinct resolution of the Volksraad. The Concessions Commission found, however, that in consequence of the resolution of the Volksraad of the 31st August, 1896, Article 1286, the Wonderfontein Concession was ratified by the Volksraad, and that such ratification made it a legally acquired one.

I am of opinion, however, that whatever opinion may be attached to a mere resolution of the Volksraad as Law, no Court of Law would hold that the Concession even though ratified by the Volksraad in manner above stated, was such a legislative act as would be required to deprive third parties of their lawful rights.

If I am right, then it appears to me there is not much value in clause 1 (*b*) of the Concession for the following reasons:—

1. If the water which rises on Wonderfontein does not flow from there in any defined channel to lower proprietors then the owners of Wonderfontein are entitled to deal with such water as they please (for they are entitled to its exclusive use) without any permission from the Government.

2. If, on the other hand, the water rising on Wonderfontein flows in a defined channel to the Mooi River, it is not in the power of the Government to deprive the riparian proprietors on that river of their lawful rights to such water. That can only be done by legislation, and in my opinion the Concession to Goch, even though ratified by the Volksraad, did not amount to such legislation.

If the Wonderfontein Concession be regarded as a legislative act there should be no hesitation. if the public interest require it, to pass the necessary legislation for enabling any public body which has acquired the rights of the owner of Wonderfontein to the remaining three-fourths of the water rising thereon to convey such water to Johannesburg for the purpose of supplying the inhabitants thereon, especially in view of the fact that practically nothing has been done under the Concession.

(Signed) RICHARD SOLOMON,
(Legal Adviser to the Administration.)

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Appendix B.

Johannesburg Water Supply.

APPENDIX B.

Report of the Government Committee appointed to report on the water supply of Johannesburg in 1895. (Appendices not printed.)

(Reprinted from the Appendix of Documents to the Transvaal Concessions Commission Report.)

Report of the Government Committee on the Water Supply for Johannesburg.

In accordance with the letter R7961/1894 and BB227/1895 the Commission appointed by the Government to examine in what way Johannesburg can be provided with good and pure drinking water has the honour to report as follows:—

The Commission is of opinion that the works for the water supply ought to be constructed by the public authorities, and that the working of the same ought to remain in their hands, as laid down in Volksraad Resolution of 22nd September, 1894.

As regards the quantity of water daily required for Johannesburg, and taking into consideration its increasing population, the Commission is of opinion that the calculations made by the town engineer, Mr. Aburrow, are correct, which calculations show that the waterworks to be constructed, must be capable of supplying two million gallons per 24 hours.

Further, the Commission reports that the existing waterworks company at Johannesburg, with the present capacity, is hardly capable of supplying 200,000 gallons of drinking water fit for consumption, were the water supply from Doornfontein Valley cut off, which might happen on account of reasons set out in the report of your Commission of last year. This quantity is only 10 per cent. of the amount required daily, and an increased supply is out of the question.

Therefore a supply is required which at any time could supply the necessary quantity of good and pure drinking water. Such a project has not necessarily included the taking over of the existing waterworks by the public authorities. This would only be advisable if suitable terms could be arranged with the existing company.

In estimating the costs of the four great projects which are examined in greater detail in this report, it is assumed that the water is carried to a high level reservoir, situated on the hill west of the town (district of Braamfontein) on Government ground.

The water supply projects which are considered according to the above-mentioned instructions are:—

NO. 1.—KROMDRAAI.

This farm is situated in the district of Krugersdorp, about 8 miles north of Krugersdorp. The farm is offered for sale by Mr. H. P. A. Pretorius for the price of £20,000. The works required for carrying the water from this point to the high level reservoir are estimated by Mr. McCowal, engineer, at £268,000.

The total quantity of water available is computed to be about 2½ million gallons per 24 hours.

The cost of conducting the water to the reservoir would be 2s. 10d. per 1,000 gallons on a daily consumption of 1,000,000 gallons. The expense which would be necessary for the building of compensation reservoirs has not been included in the above-mentioned estimated price. The quality of the water is excellent; it remains clear, the total hardness is 5.2.

The spring is one of the sources of the Crocodile River. The persons offering to sell the property assert that they have received the consent of the owners of the water rights lower down the spruit to divert the water, but such consent would not be legal by Art. 1 of Act No. 11/1894.

Further, the Commission cannot pass in silence over the fact that a protest has been lodged against the Kromdraai project. In a separate report one of the members of your Commission reports on this project, *inter alia*, that though a scheme for using this supply for the generation of electric power is under consideration, yet a diversion of two million gallons per diem for Johannesburg would not interfere with this scheme because the amount of water flowing through the Magalies and Crocodile river is so great.

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The inhabitants on the banks, on the contrary, have mentioned in the above-named protest, that the rivers at times become very low, and then no water could be diverted without interfering with their water rights. In any case the owners have the right to use the water for generating power, if the water is not thereby diverted from its natural course.

NO. 2.—JOHANNESBURG WATERWORKS COMPANY: PROJECT.

In their proposal this Company gives, in the first instance, a summary of its present condition, mentioning that during the year 1st July, 1893, to 30th June, 1894, an average of 862,000 gallons per diem has been pumped up by its works, and that an average of 486,000 gallons has been used every 24 hours, being 165 gallons per day for every customer: 36,044,000 gallons have been in reserve during this time; this was exclusive of the high level reservoir which was building. According to the chemical analysis made by Dr. Loevy, the quality of the water was good. The company's pumping power is sufficient to supply 2,024,000 gallons per diem. and according to the reports of the Company the supply of water has always been sufficient. In extension works £40,000 have been spent. How far this assertion agrees with the real facts, it is difficult to ascertain, but the everlasting complaints by the public throw doubt on their statement. The Company is ready to extend its works so that it will be in future able to comply with the increased demand, and negotiations are pending for the purchase of the farm Rooikop. The price of the water will vary from 5s. to 7s. 6d. per 1,000 gallons, as the consumption varies between one million or a half million gallons per diem.

The water will be supplied at 2s. per 1,000 gallons for public fountains, and at 4s. per thousand gallons for extinguishing fires.

As already mentioned on page 2 of this report only 200,000 gallons of pure drinking water can be supplied by this company for Johannesburg at present.

The Commission refers to a chemical analysis concerning the water annexed hereto (Annexe A) in which it is said:—

> "If it is to be decided which of the samples is preferable for a water supply, samples W W (1) W W (2) and IV. must be rejected. It is clear from their analysis that they are not spring water but rain water, which has percolated into the earth to a slight depth. Therefore the analysis of these samples cannot be considered as representing the permanent nature of the water, as it will vary with the changes in the weather."

Even if the water from the farm Rooikop, which is of an excellent quality, is added to the amount of pure water now supplied by the company, the quantity is insufficient for Johannesburg, and provision would have to be made again for increasing the supply. This project the Commission cannot recommend because the cost would exceed the amount required for a complete scheme giving an adequate supply of pure drinking water.

The quantity of water supplied by the Company's scheme would be much less in dry years, and would perhaps be inadequate. It is not to be denied that this Company has expended much money upon its works. The Commission would therefore recommend as soon as the Government resolves to execute one of the projects herein described as a public work, to enter into an agreement with the Company, if possible, to take over those works which can be used for the new water supply.

NO. 3.—VIERFONTEIN.

This farm is situated about five miles south of Johannesburg, and the water supply from it is proposed by Mr. Hamilton Smith on behalf of "The Transvaal and General Association, Limited."

The works in connection with this scheme would consist of a reservoir on the southern part of the farm, having a capacity of one thousand million gallons for collecting the rain water, running down the slopes of the hills, together with the water from the little spruits found there. If necessary a filter will have to be erected, also a service reservoir on the top of the Vierfontein hill, connected with a water tower near Ferriera's beacon for distributing the water over the town. The works will be capable of supplying one or two million gallons daily, and the cost would amount to £330,000, all rights included.

The water carried to the tower would cost 2s. per thousand gallons if two million gallons were consumed, and 2s. 9d. if one million gallons were consumed daily; consumption between these two amounts will cost in proportion. The Company is prepared to execute the works at its own expense, and to transfer the same afterwards for the above-mentioned price. In addition to this a premium of five pence per 1,000 gallons would have to be paid for a period of twelve years on a consumption of one million gallons per diem, and of 3d. on a consumption of two million gallons daily; for quantities between these two payment would have to be made proportionately. These royalties could be redeemed for £50,000.

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Appendix B.

Johannesburg Water Supply.

The farm has an excellent site for building a reservoir for collecting rain water. Your Commission, however, is of opinion that these works would be insufficient for a proper supply of water for Johannesburg, because the water must first be filtered to make it drinkable, and furthermore the water would require to be pumped to a higher level. The Commission has included in the estimate of the cost the cost of those works which are considered necessary for the supply of Johannesburg. For this reason, in this scheme (as already mentioned on page 2) in calculating the cost of the water it has been assumed that the water has to be pumped to the above-referred to high level reservoir. Therefore, the cost for executing the project will amount to £375,000, and the cost price of the water for one thousand gallons will be 1s. 6d. on a consumption of 2 million gallons per diem, 1s. 9d. on a consumption of 1½ million gallons per diem, and 2s. 4½d. on a consumption of 1 million gallons per diem.

In addition thereto, it should be taken into consideration that according to agreement with the persons with water rights lower down, they should be supplied with the same amount of water as always flows through the existing little spruits. The water supply for Johannesburg, therefore, would be limited to the rainwater only. Subtract from this amount the quantity which is lost by evaporation, and only a small amount will be left in a year of drought to dispose of. With regard to the quality of the running water, your Commission cannot report favourably, and it refers to Appendix A of this report, giving the result of a chemical analysis and bacteriological examination of a few samples of the water, from which report an extract has already been given on page 5, which extract, as far as sample IV. is concerned, refers to the running water on Vierfontein. As this water cannot be recommended as good and pure drinking water, much less will this be the case with the water which is collected running down the surface of the slopes. and not subjected to a natural filtration at all. Moreover, the water from Vierfontein is an affluent of the Klip River, and as such it comes under Art. 1, Act 11/1894. For this reason the projectors have negotiated with the owners of water rights regarding the amount of water to be diverted.

We do not consider the examples (mentioned in a separate report by a member of your Commission) of the supplies in the towns in England, or America, or even Cape Town applicable, because, as far as we know, there is no water supply in any of them exclusively dependent on rainwater. Everywhere considerable streams or importable watercourses are made to flow into a reservoir. On Table Mountain, near Cape Town, this will be effected by a tunnel.

NO. 4.—HIGHVELD SCHEME.

Mr. D. M. Wilson, at Pretoria, is the projector of this scheme, and he proposes to take the water from the farms Rietvlei and Olifantsfontein (ward Bronkhorstspruit, district of Pretoria) situated north-east of Johannesburg, at a distance of 33 miles. The quantity of water found on these two farms together amount to 4½ million gallons in 24 hours. This scheme would bring 2 million gallons per diem to Johannesburg, and at the same time supply Boksburg and other places situated along the route of the pipes. The cost is estimated at £200,000. The projector is willing to execute this work on condition that he will be exempted from the payment of import duty on the necessary materials.

As the water of Olifants River has also been offered to the Government by Mr. W. H. Boshof at Standerton, the Commission has some doubt as to who has the right of offering the same. Furthermore, the quantity of water in Rietvlei was less than 1½ millions in August, 1894, and by collecting the water on both farms for Johannesburg, the owners of water rights situated lower down would suffer damage, and it would be necessary to construct extensive and expensive compensation works; hence the Commission considers this scheme unfit to be recommended.

NO. 5.—WONDERFONTEIN SCHEME.

This project was proposed by the Sanitary Board of Johannesburg. The farm Wonderfontein is situated in the district of Potchefstroom, about 46 miles from the high level reservoir for Johannesburg, mentioned on page 2.

The difference in level between the springs and the reservoirs is 1,100 feet.

The quantity of water rising here can be safely estimated at 10 million gallons per diem. The spring is forced to rise by a dyke of greenstone cutting the underground dolomite limestone at a right angle nearly. At a distance of about two hundred yards lower down the water from this spring joins that of the Wonderfontein Spruit, which comes from Gemsbokfontein, under the same conditions as the first-named spring. The quantity of water at this point was estimated by the town engineer of Johannesburg to be 26 million gallons per diem during the whole year. From this point the two streamlets flow together for about a mile in a westerly direction, afterwards the greater part of the water disappears under the earth through a number of caves, cracks, and fissures in the rock in a northern direction. For some distance north of the entrance

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of these caves the movement of the water can be followed in the same direction. It is, therefore, not improbable that the water flows off in cross galleries or cracks parallel to the above-mentioned greenstone to an unknown depth. The remaining water of the joint streamlets runs further over the farms Stinkhoutboom and Welverdiend, upon which last-named farm it disappears in the same way as already described.

One of the members of this Commission, in a separate report, has tried to prove that the water of the Wonderfontein Spruit again reappears upon the farms Turffontein, Kiel, and Gerhardsminbron, where it forms the course of the Mooi River. This supposition is based upon the general geological characteristics of the country in that neighbourhood, and the uniform inclination of the ground between Wonderfontein and the last-named farms. It was, however, forgotten to mention that there, where the water totally disappears, a small rising of the ground shuts off the valley, and according to our opinion, the water is stopped in its further course westward. As the real conditions in this country have often contradicted the theories of the ablest geologists, and as there was no opportunity for a complete and exhaustive examination, we think, although we cannot declare it proved, that the water rising on the farms Turffontein and Kiel to be a separate natural reservoir, which has its outlets near the spring of the Mooi River on Gerhardsminbron. To confirm our opinion we may note that though repeated attempts have been made to prove that the water of the Wonderfontein Spruit is the same as that forming the spring of the Mooi River, they have always failed. We have observed amongst the documents a petition from Potchefstroom, protesting against diverting the water from the Wonderfontein Spruit to Johannesburg, at the same time, however, also a resolution of the Volksraad deciding to reject this petition.

The works in connection with this project will consist of a *prise d'eau* at the spring, three pumping stations, two intermediate reservoirs, and 46 miles of 16in. pipe; and they are estimated to cost about £462,000. The yearly expenses are computed to be: £74,000 on a daily consumption of two million gallons; £66,500 on a daily consumption of 1½ million gallons; and £59,000 on a daily consumption of one million gallons.

The price for the water on the respective consumptions per 1,000 gallons will be delivered at the reservoir at Johannesburg, 2s. 0½d., 2s. 5½d., 3s. 3d.

Included in the yearly expenses are provision for the redemption of the capital expended in erecting the works within a period of 33 years; the creation of a reserve fund of ½ per cent.; and writing off deterioration of the buildings, machinery, etc.

In this scheme we have the advantage of abundance of water, which rises from the earth, and for the greater part disappears again into it. It is, therefore, not a public stream; so no compensation reservoir would have to be built.

The building of the railway line from Krugersdorp to Potchefstroom will facilitate the supply of coal. A special concession has been granted for the Wonderfontein water project by legislation; this will prevent any legal difficulties arising. Although this scheme is apparently the most expensive, it must be taken into consideration that owing to it not being necessary to pay compensation, which over a long period of years amounts to a heavy sum, this project in the end will be cheaper than the Steenkoppies water scheme, and indeed still cheaper than the present water supply. If the Government decides in favour of this project then the town of Johannesburg becomes the owner of a water supply which, after the lapse of a comparatively short period, will cost her nothing, moreover capable of supplying a greatly increased demand, and, therefore, sufficient for the most distant future.

NO. 6.—WELTEVREDEN.

The water from this farm is offered by Mr. H. G. van der Hoven, the farm is situated 8½ miles westwards of Johannesburg, upon the northern slope of the Witwatersrand mountains. The springs have been further opened up by the owner by cuttings and tunnels, and have been considerably increased in capacity. If the question of the water rights lower down were sufficiently settled this water scheme would, in connection with the project from another spring, become feasible, but not profitable compared with the large scheme mentioned in this report.

The owner offers to supply the water at 1s. 8d. to 3s. per 1,000 gallons according as 1½ or ½ million gallons are consumed respectively. At the same time the owner is willing to sell his rights and the works executed for a price to be settled afterwards.

All the different springs on Weltevreden form effluents of the Jukscheiriver and therefore come under the provisions of the above-mentioned Act.

Your Commission has, moreover, doubts about the right of the owner to dispose as he chooses of the quantity of water with which he has increased the capacity of the springs, for hereby the quantity of water is not increased but on the contrary the water is forced to flow off too soon.

This would only cause difficulties instead of advantages during two or more successive years of drought.

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Appendix B.

Johannesburg Water Supply.

NO. 7.—GEMSBOKFONTEIN.

This project, proposed by Mr. W. H. B. Boschoff at Standerton, the Commission cannot recommand for reasons already mentioned in this report sub No. 4, Hoogeveld (Highveld) scheme.

NO. 8.—STEENKOPPIES.

The Steenkoppies project has been proposed by Mr. Sherwell, of Johannesburg. The farm Steenkoppies is situated in the district of Krugersdorp, about 33 miles westward of Johannesburg. The difference in level between the springs on this farm and the already mentioned high level reservoir is about 1,000 feet. The quantity of water rising to the surface here is estimated to be between 12 and 15 million per diem. A price of £30,000 is asked for the farm, while the cost of the proposed scheme, the farm included, would amount to £251,500. The Commission, however, following the basis mentioned in the beginning of this report has computed the cost of erecting the necessary works, including the purchase of the farm, at £369,700. The water delivered at the high level reservoir would then cost per 1,000 gallons 1s. 10½d. on a consumption of two million gallons daily; 2s. 3d. on a consumption of 1½ million gallons daily; 3s. 0½d. on a consumption of one million gallons daily.

The works would consist of a pumping station, worked by water power, near the *prise d'eau*, two other pumping stations, worked by steam power, each provided with a reservoir, the *prise d'eau*, and 33 miles of 16in. piping, and the necessary building.

The springs situated at Steenkoppies form one of the sources of the Magalies River, therefore the rights of riparian owners lower down should be taken into consideration. When those interested assert that no damage is caused to the owners of water rights below by diverting two or three million gallons for Johannesburg, this may be quite true, but the act is in itself an infringement of the right of others and cannot be allowed, according to resolution of the Volksraad, 1026/94, d.d. 22/9/1894. As for the building of a compensation dam the valley is fairly suitable. However, it is sloping too gently to collect the necessary quantity of water, and large amounts would have to be paid for compensation. Moreover, the First Volksraad has rejected by its resolution, Art. 268, d.d. 10 June, 1893, a petition for the carrying of water from Steenkoppies to Johannesburg. Although this resolution could be revised by the Volksraad and authorisation could be granted to bring the excellent and advantageously situated water supply to Johannesburg, the compensation which would have to be paid to the riparian owners lower down would have to be added to the cost for purchase of farm and the erection of the works.

This amount would be a sum which would greatly exceed the cost of the establishment of the supply, hence this scheme is so expensive that your Commission is reluctant to recommend it.

NO. 9.—GEMSBOKFONTEIN.

Proposed by Mr. Bittel, of Johannesburg. This farm is situated 26 miles south-west of Johannesburg in the district of Potchefstroom. This farm, being one-fourth of Gemsbokfontein, is offered for sale for £20,000. The quantity of water is four million gallons per day.

It would be difficult to solve the question of compensating the riparian owners as there is hardly a site for building a compensation reservoir. Moreover, the pollution of the water by the mines on Luipaardsvlei, Randfontein, and Middelvlei, it is possible, would happen.

NO. 10.—WATERVAL.

Proposed by Mr. H. W. Smith, attorney, on behalf of one of his clients. The farm is situated to the immediate north of Langlaagte, near Johannesburg.

The quantity of water amounts to 600,000 gallons per day in the dry season, and and to 1½ million gallons per day in the summer.

The projector is prepared to execute the works required for this supply under the supervision of the Sanitary Board.

He proposes to supply the water at one of the reservoirs in the neighbourhood at 2s. per 1,000 gallons on a minimum consumption of 750,000 gallons daily.

He is willing to lay down the pipes for distributing the water and to transfer these works at cost price.

The Commission is of opinion that this project closely resembles the Vierfontein scheme, and it has, moreover, the advantage of being considerably nearer Johannesburg.

The farm offered for sale is suitable for building a reservoir for collecting the rain water. This project would be the cheapest of all the schemes proposed for the supply of the town, but it cannot be recommended because the quantity of water is inadequate, and because there is danger of infection, and the water itself is not of good quality.

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NO. 11.—WITSTINKHOUTBOOM.

The water from this farm is offered by Mr. E. C. Tennant, 9.9. The farm is situated immediately south of Wonderfontein, and is offered for sale for £30,000, all rights included.

Your Commission is of opinion that the project of supplying Johannesburg with water from this place offers fewer advantages than the Wonderfontein project, and the cost would be nearly the same. The owner of this farm has only the right to take water out of the Wonderfontein river for use on his farm, after which it has to be reconducted to its natural course.

This project and the Gemsbokfontein scheme cannot therefore be considered. The holders of the Concession of the Wonderfontein project have the sole and exclusive right to bring water from the Wonderfontein river to the gold fields.

NO. 12.—OLIFANTSVLEI, MISGUND, AND KLIPSPRUIT

Have springs over which the Town Engineer of Johannesburg has reported as a possible water supply. The two first-named farms have springs situated near the Klip River at a distance of about ten miles south of Johannesburg.

The quantity of water measured on Olifantsvlei was only 400,000 gallons per day.

The Town Engineer of Johannesburg has reported unfavourably about Misgund.

Klipspruit, one of the sources of the Klip River, is situated within the limits of the gold fields.

These springs will in all probability be drained if mining in the neighbourhood is carried on to a great depth.

The quantity of water on each of the farms mentioned could only be used as forming part of a combined project.

A combined project consisting of 2 or 3 smaller schemes to produce a supply equal to one of the four great projects but able to increase the capacity as required, would cost nearly as much as one of the great schemes, *e.g.*, Steenkoppies or Vierfontein. The annual working expenses would be considerably more than in one of the other projects because of the more intricate administration required where the works are divided up into sections, and there are other objections against such a water supply.

Moreover an adequate supply of water for consumption would not be guaranteed with sufficient certainty by the project.

These are the reasons why your Commission cannot recommend this project, and why your Commission considers it more advisable to suggest one of the great schemes, even though the cost would at first be higher for the erection of the works for the water supply of Johannesburg, yet in the long run such a scheme could be worked more economically and with more profit.

We add a summary of the water schemes described in this report for the purpose of giving a short recapitulation of the result of our examination of them:—

(*a*) The projects of No. 4 Highveld, No. 6 Weltevreden and No. 12 Olifantsvlei, Misgund and Klipspruit cannot be recommended because the quantity of water is too small, and moreover because there exists some doubt in No. 4 as to who has the right to dispose of the water supply.

(*b*) In the water schemes No. 2 Waterworks Co., No. 3 Vierfontein and No. 10 Waterval the quality of the water is such that the Commission does not venture to recommend these projects. In No. 2 the quantity is also inadequate.

(*c*) Of the water schemes No. 9 Gemsbokfontein and No. 11 Witstinkhoutboom the owners are not entitled to dispose of the water to supply Johannesburg, the water forming part of the Wonderfontein Spruit. The exclusive right to this water has by Lot B Art. 1 of the Concession of 2nd March, 1891, been granted to the Concessionaires.

(*d*) The projects of No. 4 Highveld, No. 7 Olifantsvlei, No. 8 Steenkoppies and the combination project would be too expensive, compared with the other schemes, because of the compensation works and the compensation money which would be required to be paid. The Commission therefore declines to recommend either of these schemes.

(*e*) All the projects No. 1 Kromdraai, No. 3 Vierfontein, No. 4 Highveld, No. 6 Weltevreden, No. 7 Olifantsvlei, No. 8 Steenkop, No. 9 Gemsbokfontein, No. 10 Waterval, and No. 12 Olifantsvlei, Misgund and Klipspruit come under the provisions of Act No. 11 of 1894.

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Appendix B.

Johannesburg Water Supply.

The Wonderfontein project is the only one which does not infringe private rights, and which can be immediately executed without any further special legislation or any resolutions of the Volksraad. This project does not require compensation works, nor has compensation money to be paid, and it provides an adequate supply of good and pure water. This scheme further complies in all respects with the provisions of the Act mentioned above, and with the resolution of the First Volksraad Act 1820, d.d. 22nd September, 1894.

The opinion has been expressed on page 6 of this report that it would be advisable for the Government to take over the existing works of the Waterworks Company at Johannesburg if one of the greater schemes were adopted by the Government. If reasonable conditions cannot be agreed upon for taking over the Company's works which might be required to carry out the great project, no anxiety need be felt for the continued existence of the Company. The population of Johannesburg is increasing so rapidly that the consumption of water, according to statements made by the Chairman of the Company, by the present inhabitants which are served by the existing waterworks exceeds 1½ million gallons per day. The consumption of water would therefore even after the completion of the great scheme increase to such an extent that the two supplies would have quite sufficient work to do to satisfy the increasing demands of the population.

Annexed to this report is a general map, on which the different farms have been indicated in the same order as described herein, from which it has been proposed to conduct water to Johannesburg. The different lines of pipes have been roughly indicated in the map.

Also there is annexed a report of the chemical analysis and bacteriological examination of the different samples of water taken from the springs of the most important of the proposed supplies made by Dr. Edward Kleiner.

Your Commission is now of opinion that it has finished its task, and we have the honour to be

Hon. Sir,

Yours faithfully,

(Signed) J. M. A. WOLMARANS.

(Signed) E. LUTZ, Engineer,
Secretary of the Commission.

Pretoria, October, 1895.

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APPENDIX C.

Letters from Resident Magistrates at Boksburg and Krugersdorp with regard to population of those places.

C. 1.

Letter from the Resident Magistrate, Boksburg, giving the number of houses and inhabitants in the district:—

RESIDENT MAGISTRATE'S OFFICE,
BOKSBURG, 10th February, 1902.

The Secretary,
Witwatersrand Water Supply Commission,
Johannesburg.

SIR,—

In reply to your letter dated the 4th instant, I beg to state that as regards Boksburg itself which includes the suburb of Vogelfontein there are 219 houses including 9 houses of natives with a white population of 983 and coloured 189.

Including the East Rand Mines, Native Refugee Camp within a radius of one mile of the Market Square, Boksburg, there are in addition 1,275 whites, 1,991 natives and 37 Asiatics. I have not yet succeeded in getting the figures for the native employees on the East Rand Proprietary Mines.

The above figures represent the present population excluding the Mines and Refugee Camps. In normal times the population of whites will probably be double and the native treble the above figures.

I have the honour to be,

Sir,

Your obedient Servant,

(Signed) G. H. POMEROY COLLEY, Capt.,
Acting Resident Magistrate.

C. 2.

Letter from the Resident Magistrate, Krugersdorp, giving the number of houses and inhabitants in the district:—

RESIDENT MAGISTRATE'S OFFICE,
KRUGERSDORP, 22nd February, 1902.

SIR,—

I have the honour to acknowledge the receipt of your letter of the 4th instant, and to inform you that the number of houses in the district of Krugersdorp is estimated at one thousand six hundred, not including one hundred and seven houses in the Native Location.

The population in normal times is said to be ten thousand whites and thirty thousand natives. I should add that these figures are at best rough estimates.

In considering the question your Commission will no doubt have regard to the possibility of a considerable increase of population.

I have the honour to be,

Sir,

Your obedient servant,

(Signed) R. A. POORE, Capt.,
Resident Magistrate.

To the Secretary,
Witwatersrand Water Supply Commission.

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Appendix D.

Mr. G. H. Goch.

APPENDIX D.

Documents referred to by Mr. G. H. Goch, in his evidence on behalf of the Wonderfontein Concession.

D 1.—Mr. Way's report on Gaugings at Wonderfontein, dated 16th November, 1897.

D 2.—Mr. Sykes' report on Gaugings at Wonderfontein, dated 8th November, 1897.

D 3.—Mr. Sykes' further report on Gaugings at Wonderfontein, dated 13th November, 1897.

D 4.—Topographical Sketch of Wonderfontein.

D 5.—Report by Sir William Crookes and Professor Dewar on Wonderfontein Water, dated 16th July, 1901.

D 6.—Report by Mr. Walter Hunter on Wonderfontein Water, dated 29th July, 1901.

D. 1.

Mr. Way's report on gaugings at Wonderfontein, dated 16th November, 1897:—

JOHANNESBURG,
16th November, 1897.
P.O. Box 540.

GEO. HESSE, ESQ.,
JOHANNESBURG.

WONDERFONTEIN WATER.

DEAR SIR,—

Acting upon your telegram of October 21st and upon the results of several interviews with you, I obtained permission from my Directors to carry out your wishes and arrange to proceed to Wonderfontein on Tuesday, November 2nd.

Circumstances over which I had no control prevented me going at the last minute, but I was able to send a representative who has done a considerable amount of surveying with me of the kind wanted and upon whose figures I could rely as if they were my own.

I had previously arranged all the methods and principles by and upon which the survey was to be made, and it was only a question of obtaining accurate data and therefrom accurate results, to arrive at the information required.

SURVEY AND PLANS.

I decided after getting all the information possible that the only kind of survey possible was a "float" survey and the necessary apparatus was prepared for it.

I now beg to submit the accompanying plans and cross sections. On the general plan* I have shewn the position of the springs with regard to the surrounding country together with the points where the streams were gauged, which points for the sake of reference I have marked A. B. and C. on the plan.

On the cross sections you will find the exact width and depth of the streams shewn where gauged and these measurements will be valuable to your client if at any time he wishes the variations in the flow checked.

The season of the year could not have been more favourable for gauging the *minimum* quantity coming from the springs as no rain had fallen since the last rainy season. Consequently the figures given below show very accurately the minimum quantity of water obtainable at the dryest season of the year.

I am not acquainted with the exact nature of your client's holdings with regard to all the water at Wonderfontein, but I would draw your attention to the fact that the stream known as "Wonderfontein Loop" is being used for irrigation and other purposes; and as the demand on this loop is likely to increase rather than decrease, I am of opinion that no reliance should be placed on the water obtainable from this source, and that the supply derivable from the springs alone should be considered.

* Not printed.

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The following tabulated statement shows the total discharge in gallons per 24 hours from the streams severally and combined:—

Portion gauged.	Mean Velocity, ft. per Sec.		Average Mean Velocity, ft. per sec.	Area of Cross Section. sq. ft.		Average area of cross section.	Discharge in gallons per 24 hours.
A	G. H.	1·75	1·59	A. B.	26·82	30·20	25,717,824
	I. J.	1·51		C. D.	30·20		
	K. L.	1·51		E. F.	38·58		
B	E. F.	0·62	0·57	A. B.	15·59	15·59	4,797,216
	G. H.	0·54					
	I. J.	0·57					30,515,040
C	G. H.	1·80	1·57	A. B.	8·29	10·74	9,028,800
	I. J.	1·57		C. D.	11·63		
	K. L.	1·36		E. F.	9·73		
							21,486,240

REMARKS.

30,515,040.—Total discharge from combined streams.
9,028,800.—Discharge from Wonderfontein Loop.
21,486,240.—Discharge from Wonderfontein Spring.

SYSTEM OF GAUGING.

As the stream for some considerable distance below the springs is thickly overgrown with reeds some difficulty was experienced in obtaining suitable places for gauging.

The position at A. B. was fixed as being most suitable.

Here the main stream is divided into two arms which are separated by the growth of reeds and it was found necessary to gauge each arm separately, the sum of the results being the total discharge from the springs and the "Wonderfontein Loop" taken together, the junction being some 300 yards above these places.

To obtain the actual discharge from the springs the "Wonderfontein Loop" was gauged at a point C. on the plan and the discharge thereof being subtracted from the sum of discharges at points A. and B. gave the discharge from the springs alone.

Owing to the size of the stream it was not practical to gauge the quantities by means of weirs. This method of measurement is, however, the most accurate. The "float" survey was the only method possible, and upon this particular care was bestowed and the results may be thoroughly relied upon.

After having selected as straight and fair a run of stream as possible, distances were staked and lined off at right angles to its course. At intervals from 2 to 3 feet apart along these lines measurements of levels were taken to ascertain the mean depth of the cross sections. The cross sections were made at each section gauged, and from their mean, the cross sectional areas were calculated.

The mean velocities were obtained by direct experiment in the following manner:—Two floats made of indiarubber in the form of hollow spheres about 3 inches diameter were connected together by an adjustable cord long enough to permit the spheres to reach from the surface to a point near the bed of the stream.

The lower sphere was loaded sufficiently to sink the upper one so that the latter was just visible on the surface. The velocities of the various travels of this apparatus represented the velocities of the streams.

The advantage of the lower loaded float is that the slightest obstruction to the lower float or to the cord connecting it to the upper one becomes at once apparent and in the event of any such obstruction being noticed the trial is rejected.

After making several satisfactory experiments both in the centre of the stream and at the sides, the mean was taken and is given in the tabulated statement of velocities before referred to.

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Appendix D.

Mr. G. H. Goch.

GENERAL.

On November 4th I handed you a statement to cable to your client of which a true copy is set below:—

GEO. HESSE, ESQ.,

JOHANNESBURG.

WONDERFONTEIN WATER.

DEAR SIR,—

I beg to report to you for the purposes of cabling to Mr. Goch that I have gone into Mr. Davidson's figures and they show that the flow of water is as follows:—

Discharge from Wonderfontein Spring		21,486,240	gals. per day.
" " "	Loop	9,028,800	" "
Total available	...	30,515,040	" "

My full report with diagram will follow as soon as possible.

I am, Dear Sir,

Yours faithfully,

(Signed) EDWARD J. WAY.

and I submit the figures and facts of this report in confirmation of above and trust they will prove of value to your client.

I have the honour to be,

Dear Sir,

Yours faithfully,

(Signed) EDWARD J. WAY.

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D. 2.

Appendix D.
Mr.
G. H. Goch.

Mr. Sykes' report on gaugings at Wonderfontein, dated 8th November, 1897:—

November 8th, 1897.

MESSRS. JAMES SIMPSON AND CO., LTD.,

LONDON.

DEAR SIRS,—

In accordance with your request I went out on Tuesday last to Wonderfontein to measure the water on that farm. Mr. Way was at the last moment unable to accompany me owing to an accident on the George Goch Mine. I, however, took his Surveyor with me; he is drawing up a detailed report which will be sent to Mr. Goch for your use.

I found it extremely difficult to get a suitable place for measuring the water but our observations were taken with great care, and from what I could learn, the water has never been measured with anything approaching the same accuracy on any previous occasion. On my return I cabled you as follows: "Water at juncture 30½ millions, weather very dry," and Mr. Hesse sent a similar cable to Mr. Goch. This is the result of Mr. Way's surveyor's calculations. I had them run out by an independent engineer with approximately the same result. Owing to pressure of business I have been unable yet to go carefully through the figures, but going through them hurriedly, make the quantity over 30 millions. Will give you the sections and write you further on the subject by next mail. Referring to rough sketches* you will see that the majority of the water passes the point Z, and that the principal part of this water is supplied by springs in the swamp immediately above, the whole of which is on the farm under consideration. Finding that the Wonderfontein Loop (also known by the name Gemsbokfontein Spruit) ran with the same stream, I considered it advisable to measure this separately, as it rises some distance away from the Wonderfontein property and at some future period might possibly be unsuitable or unavailable for pumping to Johannesburg. You will see that, apart from this, there is over twenty million gallons per 24 hours available which has its source in the swamp on the farm. I have Mr. Hunter's letter to Mr. Aburrow on the subject; in this he asks for the rainfall for the present year. I will send you this for Johannesburg, which is the nearest point at which any record has been kept and is practically useless. During October the rainfall in Johannesburg has been about three inches; this has been entirely from thunder-storms (nearly one inch fell in fifteen minutes). At Wonderfontein there has been practically no rain: this fact is evident from the state of the velt in addition to being verified by every one from whom I was able to inquire. I do not consider a more favourable time could possibly have been selected for measuring the water at its lowest, it might, however, be more satisfactory to you to have it measured again in the course of a week or two should there still be no rain.

You will notice that in measurements Z and X, I have given you the mean time; the float used was two tennis balls united by a line, the one being weighted so as to travel about 3 inches from the river bed, the water at Y was too shallow to use other than a surface float.

I am, Dear Sirs,

Yours faithfully,

(Signed) S. SYKES.

* Not put in.

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Appendix D.

Mr. G. H. Goch.

D. 3.

Mr. Sykes' further report on gaugings at Wonderfontein, dated 13th November, 1897:—

November 13th, 1897.

MESSRS. JAMES SIMPSON AND CO., LTD.,
LONDON.

WONDERFONTEIN WATER SCHEME.

DEAR SIRS,—

Referring further to my letter of last week and rough sketches, I make the quantities as follows:—

Main Stream measured at Z.

Section	A.B.	area 26·835 ft.	x 1	equals ...	26·835
„	C.D.	„ 30·200 „	x 4	„ ...	120·800
„	E.F.	„ 33·585 „	x 1	„ ...	33·585
					6)181·220
				Main area equals ...	30·2

mean time 21·5 sec., per 34·083 feet equals mean velocity 1·585 ft. per sec., x 30·2 equals cu. ft. per sec., 47·867 x 6·23 equals gallons per sec.. 298·21 equals 25,765,346 gallons per 24 hours.

This was measured on the first day, the velocities would really be slightly higher on the second day owing to increased quantity of water in Wonderfontein Loop.

Branch stream measured at Y, Section A.B., area 15·64, surface time 43·6 sec., per 27·83 ft., equals surface velocity ·638 ft. per sec., x ·8 equals mean velocity ·51 ft. per sec., x 15·64 equals cu. ft. per sec. 7·976 x 6·23 equals gallons per sec., 49·69—4,273,216 gallons per 24 hours.

This was measured over space out of which reeds had to be cleared and we had to take what appeared to be a fair average section; bottom was too uneven to get mean velocity with floats.

Wonderfontein Loop measured at X.

Section	A.B.	area 8·31 ft.	x 1	equals ...	8·31
„	C.D.	„ 12·39 „	x 4	„ ...	49·56
„	E.F.	„ 9·75 „	x 1	„ ...	9·75
					6)67·62
				Mean area equals ...	11·27

mean time 28·27 sec., per 45 ft. equals mean velocity 1·568 ft. per sec., x 11·27 equals cu. ft. per sec., 17·67 x 6·23 equals gallons per sec., 110 equals 9,504,000 gallons per 24 hours.

Main stream at Z	25,765,346
Branch „ „ Y	4,273,216
Total discharge at Junction	30,038,552
Less Wonderfontein Loop	9,504,000
Total amount of water having its rise on farm	20,534,552

On the first day we found very little water running in Wonderfontein Loop which we were informed was owing to a dam at a mile above having burst; on the second day the dam had evidently been filled and the quantity of water in Loop was almost doubled. As dry weather has continued am considering the advisability of going out again next week.

I am, Dear Sir,

Yours faithfully,

(Signed) S. SYKES.

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D. 5.

Appendix D.

Mr. G. H. Goch.

Report by Sir William Crookes and Professor Dewar on Wonderfontein Water, dated 16th July, 1901:—

LABORATORIES,

14, COLVILLE ROAD,

LONDON, W.,

July, 16th, 1901.

WALTER HUNTER, ESQ., M. INST. C.E.,

17, VICTORIA STREET, S.W.

WONDERFONTEIN WATER.

DEAR SIR,—

We have read and considered the Report D. 1 of the Government Committee on the Water Supply for Johannesburg, given on p.p. 285-290 of the Report of the Transvaal Concessions Commission, dated 19th April, 1901, Part III, Appendix of Documents, and more especially have maturely considered the inferences to be drawn from the various analyses in Appendices A and B, p.p. 288-290.

Inclusive of the Pretoria water, analyses of nine separate samples are given, and these analyses all seem to have been carefully executed by Dr. Edward Kleiner of Pretoria. We say that of the eight samples (excluding that from Pretoria of which the analyses are given) the water from Wonderfontein marked III, is, in our judgment, undoubtedly one of the best, and in general character it closely resembles in composition the Pretoria water, which is admitted to be unexceptionable in quality. Further, the fact that the Wonderfontein water is from a spring, rising in the dolomitic formation, and of such an exceptional character as to actually yield as much as 26 million gallons per diem, is sufficient to explain its freedom from organic matter, and the general degree of hardness and total solids, which in this water are not excessive.

From a consideration of the geological map we see no reason why the spring water at Wonderfontein should not be completely isolated from any possible contamination from the spruit water, which may be polluted more or less by drainage from the mines on the Rand.

If this spring is impounded and conveyed, in the manner suggested in the Government Report, to Johannesburg, we consider that city will be in the very fortunate position of possessing a supply of potable water of very high quality and in enormous quantity, entirely derived from deep springs, and therefore giving no anxiety as regards organic contamination or the presence of injurious microbial organisms.

We remain,

Very truly yours,

(Signed) WILLIAM CROOKES.

(Signed) JAMES DEWAR.

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Appendix D.

Mr. G. H. Goch.

D. 6.

Report by Mr. Walter Hunter on Wonderfontein Water, dated 29th July, 1901:—

17, VICTORIA STREET,
WESTMINSTER, S.W.,
July 29th, 1901.

WONDERFONTEIN WATER.

DEAR SIR,—

In accordance with your request I now put into more formal shape the suggestion which I made in my letter of July 24th, that upon the terms of your present concession there should be no difficulty, with the assistance of a storage reservoir of moderate capacity, in supplying an average quantity of 10,000,000 gallons daily from Wonderfontein Spring.

When the combined streams were gauged in the first week of November, 1897, when, to quote the words of Mr. Way, "practically no rain had fallen at Wonderfontein" since the previous wet season, the total quantity passing was 30,500,000 gallons in 24 hours, which would permit under the Concession an abstraction of, say, 7,500,000 gallons daily, which would be the minimum quantity available.

On the other hand, the maximum in March was given by Mr. Aburrow at 54 million gallons per diem, of which 13½ million gallons would be available.

As the rains at Johannesburg sometimes begin in October and end in April, it appears probable that the following surpluses and deficiencies may be expected in a year:—

					Surpluses m.g.	Deficiencies m.g.
January	+	3·5 m.g.	× 31	=	108·5	
February	+	3·5 m.g.	× 28	=	98·0	
March	+	3·5 m.g.	× 31	=	108·5	
April	+	3·5 m.g.	× 30	=	105·0	
May	+	2·5 m.g.	× 31	=	77·5	
June	+	0	× 30	=		
July		0	× 31	=		
August		0	× 31	=		
September	—	1·5 m.g.	× 30	=		45·0
October	—	2·5 m.g.	× 31	=		77·5
November	—	2·5 m.g.	× 30	=		75·0
December	—	0	× 31	=		
					497·5	197·5

The storage required is therefore 200 m.g. net, and if to this be added 50 per cent. to allow for extra demand for domestic purposes during the hot season and for evaporation, a reservoir of 300 m.g. capacity will be required, to fill which during the wet months 500 m.g. will be available.

The additional capital expenditure necessary will be that due to the cost of the reservoir and to the increase of the engine capacity from 10 m.g. to 13·5 m.g. daily.

The interest upon this extra expenditure with a slight additional cost for maintenance will be the only additional revenue charge, as the cost of pumping, except so far as is necessary to make up waste caused by evaporation, will not be increased.

In regard to my suggestion that it may probably be desirable to construct the proposed reservoir near Krugersdorp so as to have water available should any accident happen to the first two lines of main, I am glad to hear from you that the configuration of the land near that town provides the opportunity of making the reservoir with a comparatively small expenditure of capital.

Referring to your alternative proposal to take water from the subterranean supply, over which you have a right to a surface area 200 yards square at the entrance of the lake, this may prove to be a valuable adjunct to the supply. I am of opinion, however, that it is desirable, at any rate in the first instance, to rely upon the spring alone in conjunction with a storage reservoir for giving the required supply.

Yours faithfully,

(Signed) WALTER HUNTER.

G. H. GOCH, ESQ.,
Hotel Metropole.
London, W.C.

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APPENDIX E.

Appendix E.
Mr.
R. L. Cousens

Memorandum on Vaal River Scheme.

WATER SUPPLY SCHEME,

By means of water-power from the Vaal River.

Proposed supply of

TEN MILLION GALLONS PER DIEM.

The memorandum already submitted to the Commission refers to what we call the "Smaller Scheme." The outline of the "Larger Scheme" will be found hereunder, as well as some further preliminary particulars:—

SMALLER SCHEME.

To take water out of the Vaal River at a point about 5¼ miles above Engelbrecht's Drift by means of a canal taking the water to a point close to Engelbrecht's Drift where the power plant would be located, the fall between the two points (*i.e.*, 5¼ miles above Engelbrecht's Drift and Engelbrecht's Drift itself) being 90 feet. Then to pump the water by water-power to an intermediate station, say at the Black Reef (Farm Roodekop), and from there pumping it to Johannesburg and the mines on the Witwatersrand by motors driven by electric power, such power being generated at the main works at Engelbrecht's Drift by means of turbines driven by water, substantially as detailed in the previous memorandum submitted to the Commission.

The estimate of cost of this scheme on a basis of supplying 10,000,000 gallons of water per diem is as follows:—

For Hydraulic Works	£142,000	0	0
„ Pumping and Generating Station	56,470	0	0
„ Overhead Transmission Line	26,517	0	0
„ Intermediate Pumping Station	34,028	0	0
„ Intermediate Reservoir, 100 feet × 100 feet × 10 feet	15,000	0	0
„ Freight and Delivery of Machinery ...	15,000	0	0
„ Erection of Machinery and Plant, including Foundations	40,000	0	0
„ Contingencies	10,000	0	0
	£339,015	0	0
„ 40 Miles of 30-inch Pipe laid and erected ...	450,000	0	0
	£789,015	0	0
„ Holders of Riparian Rights' Contracts ...	25,000	0	0
Total	£814,015	0	0

LARGER SCHEME.

This proposal involves the abandonment of the canal scheme, and in place thereof the construction of a dam wall 120 feet high at the foot of the falls at Engelbrecht's Drift; such a dam or reservoir would hold 209,088 million gallons of water. This storage capacity, after making every allowance, would be sufficient to drive the turbines and supply the town and suburbs of Johannesburg, as also the mines on the Witwatersrand, with ten million gallons of water per diem for a period of nine months assuming the Vaal River ceased to flow, and at the same time send down the river a larger supply of water to lower riparian owners than they at present enjoy in the dry season: *or* it would supply, with the river running as usual, a constant supply of thirty million gallons per diem, besides yielding sufficient for the turbines, etc. The water in the dam would cover an area of from 30 to 40 square miles. The water would be pure and soft, and a large surplus would exist for irrigation works on a large scale below Engelbrecht's Drift on the Transvaal side of the river, as also on the Orange River Colony side.

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Appendix E.

Mr. R. L. Cousens

The cost of the Larger Scheme would be approximately as follows:—

For Cost of Smaller Scheme as above	£789,015	0	0			
„ Less cost of Canal and Small Reservoir	142,000	0	0			
				£647,015	0	0
„ Cost of Large Dam				450,000	0	0
				£1,097,015	0	0
„ Holders of Riparian Rights' Contracts ...				25,000	0	0
				£1,122,015	0	0

The main advantages of the scheme are as follows:—

(*a*) The capability of yielding the enormous and regular supply of 30 million gallons per diem of good, pure, soft water.

(*b*) The saving of cost of working by concentrating all hydraulic works at one point.

(*c*) The superiority of soft river water over that taken from the dolomite formation.

(*d*) The working expenses must be lower than those of any other scheme because all pumping is done by water-power.

(*e*) The benefit to lower riparian owners of 330 million gallons of water per diem flowing down the river even in the driest seasons.

(*f*) It enables profitable and extensive irrigation works to be carried out at comparatively small cost, tending to the welfare of the two Colonies interested in that portion of the river.

(*g*) The water could be delivered at Johannesbuag, with considerable profit, at 2s. per 1,000 gallons, and probably at 1s. per 1,000 gallons.

pp. REUNERT AND LENZ.

(Signed) ALFRED CLARKE.

(Signed) R. LEWIS COUSENS.

Johannesburg.
December 14, 1901.

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APPENDIX F.

Appendix F.

Mr. G. S. B. Andrews.

Documents referred to by Mr. G. S. B. Andrews in his evidence on behalf of the Johannesburg Town Council.

F. 1.

TABLE EXTRACTED FROM RAFTER AND BAKER'S "SEWAGE DISPOSAL IN THE UNITED STATES"—SHOWING THE AVERAGE CONSUMPTION OF WATER IN UNITED STATES GALLONS PER CAPITA IN CITIES OF THE UNITED STATES WITH A POPULATION OF OVER 60,000 IN 1890.

Name of City.	Population.	Daily Consumption.		Population per Tap or House Connection.	Percentage of Increase in Population in 10 Years.
		Total.	Per Inhabitant.		
		United States Gallons. (6 United States equal to 5 Imperial.)			
New York	1,515,301	121,000,000	79	13·9	25·62
*a*Chicago	1,099,850	152,372,288	140	—	118·58
*b*Philadelphia	1,046,964	137,736,703	132	6·1	23·58
*c*Brooklyn	806,343	55,000,000	72	8·7	42·30
St. Louis	451,770	32,479,000	72	14·8	28·89
*d*Boston	448,477	42,173,100	80	6·6	23·60
Baltimore	434,439	40,978,229	94	5·8	30·73
San Francisco	298,997	18,359,000	61	9·9	27·80
*e*Cincinnati	296,908	33,997,007	112	8·5	16·37
*f*Cleveland	261,353	27,787,158	103	8·7	63·20
Buffalo	255,664	47,517,137	186	6·3	64·80
New Orleans	242,039	8,976,715	37	54·0	12·01
*g*Pittsburg	238,617	36,000,000 11,509,000	144 153	— 8·2	52·58
*h*Washington	230,392	36,588,629	158	6·5	29·71
Detroit	205,876	33,208,067	161	5·1	76·96
Milwaukee	204,468	22,380,788	110	11·1	76·90
*i*Newark	181,830	14,079,793	76	8·6	33·20
Minneapolis	164,738	12,416,117	75	16·5	251·35
j Jersey City	163,003	19,300,000	97	—	35·02
Louisville	161,129	11,874,688	74	11·9	30·20
*k*Omaha	140,452	14,000,000	94	24·0	360·23
Rochester	133,896	8,800,000	66	5·4	49·83
St. Paul	133,156	8,000,000	60	12·7	221·07
*l*Kansas	132,716	12,000,000	71	15·3	137·91
*m*Providence	132,146	6,743,092	48	9·4	26·02
Denver	106,713	20,000,000	187	7·0	199·51
Indianapolis	105,436	7,500,000	71	35·6	40·48
Allegheny	105,287	25,000,000	238	7·0	33·81
Columbus	88,150	6,882,333	78	11·5	70·68
*n*Syracuse	88,143	6,000,000	68	21·5	70·19
Worcester	84,655	4,971,340	59	8·9	45·23

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Appendix F. Mr. G. S. B. Andrews.

TABLE EXTRACTED EROM RAFTER AND BAKER'S "SEWAGE DISPOSAL IN THE UNITED STATES"—SHOWING THE AVERAGE CONSUMPTION OF WATER IN UNITED STATES GALLONS PER CAPITA IN CITIES OF THE UNITED STATES WITH A POPULATION OF OVER 60,000 IN 1890.—(*Continued.*)

Name of City.	Population.	Daily Consumption.		Population per Tap or House Connection.	Percentage of Increase in Population in 10 Years.
		Total.	Per Inhabitant.		
		United States Gallons. (6 United States equal to 5 Imperial.)			
Toledo	81,434	5,842,768	72	18·6	62·42
Richmond	81,388	13,597,102	167	7·9	27·97
New Haven	81,298	11,000,000	135	—	29·29
Paterson...	78,347	10.000,000	128	11·8	53·53
Lowell	77,696	5,127,199	66	9·2	30·64
Nashville	76,168	11,153,885	146	14·9	—
Fall River	74,398	2,136,182	29	14·9	51·95
Cambridge	70,028	4,489,180	64	6·6	32·96
Atlanta	65,533	2,359,564	36	20·0	75·18
Memphis	64,495	8,000,000	124	11·9	92·0
Wilmington	61,431	6,984,912	113	5·0	44·62
Dayton	61,220	2,848,926	47	20·1	58·28
Troy	60,956	7,608,468	125	10·5	7·42

AVERAGE OF TOWNS (COLUMN 4), 99 UNITED STATES GALLONS, EQUAL TO 82 IMPERIAL GALLONS.

Compiled from Official Returns included in the Manual of American Waterworks for 1890-91. Edited by M. N. Baker.

Populations are according to the 1890 Census, and for the whole city, regardless of the proportion of the population supplied.

a CHICAGO.—Figures are for main city works. Estimated populations supplied by small public plant built by former village of Washington Heights, and of former village of Pullman, supplied by a company. A total of 14,850 was deducted in finding averages.

b PHILADELPHIA.—Estimated populations of Holmesburg and Tacony, supplied by companies, 6,964.

c BROOKLYN.—Long Island Water Supply Company supplies Twenty-sixth Ward, with population of 29,505.

d BOSTON.—Supplies Somerville, with population of 40,152; Chelsea, 27,909; Everett, 11,068; total. 527,606.

e CINCINNATI.—Supplies Avondale and Clifton, with populations of 4,473 and 1,200, latter estimated; total, 302,581.

f CLEVELAND.—Supplies Brooklyn and West Cleveland, with populations of 4,585 and 4,117; total, 270,055.

g PITTSBURG.—Monongahela Water Company supplies "South Side" and outside towns with estimated aggregate population of 75,000.

h WASHINGTON.—Figures are for July 1, 1891, and population is for the whole district of Columbia, the government of which and of Washington is now co-extensive.

i NEWARK.—Supplies Belleville, through meter, population of which is 3,487; total, 185,317.

j JERSEY CITY.—Figures are for 1889. Supplies Bayonne, population of 19,033; Harrison, 8,338; and Kearney, 7,064; total, 197,483. Report did not state whether total average daily consumption includes supply to above places, but it is assumed that it did.

k OMAHA.—Supplies South Omaha; population 8,026; total, 148,478.

l KANSAS CITY.—Supplies Kansas City, Kan., with population of 38,316; total, 171,032.

m PROVIDENCE.—Supplies population in adjacent towns, estimated at 7,854; total, 140,000.

n SYRACUSE.—Figures are for December, 1891 (approximate).

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F. 2.

TABLE FROM FANNING'S TREATISE ON HYDRAULIC AND WATER SUPPLY ENGINEERING, SHOWING INCREASE OVER A NUMBER OF YEARS IN THE AVERAGE DAILY SUPPLY PER HEAD IN VARIOUS CITIES IN THE UNITED STATES CONSEQUENT ON "THE LEGITIMATE USE OF WATER BEING STEADILY POPULARISED."

Boston ...	...	...	55	gallons in	1866 to	105 gallons in	1890.
Buffalo ...	...	...	58	„	1870 to 186	„	1890.
Brooklyn	...	...	17	„	1862 to 72	„	1890.
Cleveland	...	...	8	„	1857 to 106	„	1890.
Cincinnati	...	...	39	„	1862 to 114	„	1890.
Chicago ...	...	...	33	„	1858 to 138	„	1890.
Detroit ...	...	...	55	„	1856 to 161	„	1890.
Jersey City	...	...	75	„	1858 to 118	„	1890.
Louisville	...	...	9	„	1861 to 69	„	1890.
New York	...	...	62	„	1864 to 79	„	1890.
Philadelphia	...	...	46	„	1867 to 131	„	1890.
Washington	...	...	127	„	1870 to 158	„	1890.

In some cases the number of gallons per day in 1890 given in this table does not quite agree with the table given by Rafter & Baker, but the percentage of difference, except in the case of Boston, is very small.

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F. 3.

COMPARATIVE TABLE OF RAINFALL IN JOHANNESBURG, 1889-1901.

Month.	1889.		1890.		1891.		1892.		1893.		1894.		1895.		1896.		1897.		1898.		1899.		1900.		1901.	
	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.
January	5·13	10	6·14	9	10·21	12	6·61	17	No Record taken.	No Record taken.	4·59	14	3·82	15	1·65	5	9·71	17	8·93	19	7·12	18	9·28	16	5·20	17
February	3·15	7	3·47	8	8·09	12	5·11	11			7·16	16	4·57	9	3·71	10	4·99	10	5·95	10	2·91	5	4·17	11	2·72	7
March	2·00	3	1·61	5	5·55	17	3·83	12			4·885	13	7·02	11	1·95	8	3·94	9	2·82	15	2·04	9	1·10	7	6·96	17
April	1·30	5	2·17	7	5·16	11	1·41	4			1·505	7	2·01	9	1·70	7	·56	5	·44	4	2·97	14	1·87	6	4·28	7
May	Nil.	Nil.	Nil.	Nil.	1·12	7	1·09	5			2·79	9	·23	3	1·26	7	·53	2	1·50	7	·85	3	Nil.	Nil.	·26	2
June	Nil.	Nil.	Nil.	Nil.	·71	2	·09	1			·135	3	·12	1	·64	3	Nil.	Nil.	Nil.	Nil.	·12	1	·14	2	·22	1
July	Nil.	Nil.	·75	3	Nil.	Nil.	Nil.	Nil.			Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	·34	3	·66	2	Nil.	Nil.
August	Nil.	Nil.	Nil.	Nil.	·56	1	Nil.	Nil.			·85	3	Nil.	Nil.	·79	5	·19	1	·20	1	·04	1	1·52	3	·20	3
September	1·00	5	·10	2	·05	1	2·03	9	2·76	6	2·32	10	·33	1	·45	3	·10	2	1·01	4	2·02	2	Nil.	Nil.	1.68	4
October	·25	3	·18	3	1·44	8	3·68	13	2·448	12	·45	3	·06	2	2·40	7	3·27	13	·64	7	2·68	11	2·39	7	5·43	9
November	5·02	16	3·89	14	2·32	13	2·20	10	8·09	14	4·92	14	3·99	13	2·46	9	2·19	7	2·60	8	2·87	11	7·94	16	4·12	9
December	2·00	10	7·63	18	5·64	15	1·49	12	5·51	16	5·80	13	6·99	12	6·22	18	3·50	14	4·90	11	4·61	11	3·73	12	4·41	13
Totals	19·85	59	25·94	69	40·85	99	27·54	94			35·405	105	29·14	76	23·23	82	28·98	80	28·99	86	28·57	89	32·80	82	35·48	89

Average Rainfall for Twelve Years = 29·73 Inches.

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F. 4.

TABLE OF EVAPORATION IN JOHANNESBURG FOR ONE YEAR FROM 19TH SEPTEMBER, 1898, TO 18TH SEPTEMBER, 1899.

September	2·665
October	7·255
November	6·609
December	6·867
January	8·347
February	6·316
March...	3·797
April	4·264
May	3·484
June	2·829
July	3·000
August	4·155
September	2·493
Average evaporation per annum	62·081 inches.

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Appendix G.

Mr. T. Stewart and Mr. T. Raynes.

APPENDIX G.

Documents referred to by Mr. Stewart and Mr. Raynes in their evidence on behalf of the Johannesburg Waterworks, Estate and Exploration Company.

G. 1.

THE JOHANNESBURG WATERWORKS ESTATE AND EXPLORATION CO., LTD.

MONTHLY RAINFALL FOR YEARS 1897, 1898, 1899, 1900, AND 1901, AS OBSERVED AT THE PUMPING STATIONS OF THE JOHANNESBURG WATERWORKS COMPANY.

Month.	1897 Stations.		1898. Stations.			1899. Stations.			1900. Stations.			1901. Stations.		
	No. 1.	No. 3.	No. 1.	No. 3.	Zuurbekom.	No. 1.	No. 3.	Zuurbekom.	No. 1.	No. 3.	Zuurbekom.	No. 1.	No. 3.	Zuurbekom.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January	7·84	7·77	7·61	5·23		6·66	3·36	4·24	9·00	8·09	5·99	5·68	5·11	4·91
February ...	3·20	3·49	5·18	5·59		2·78	6·06	1·20	3·66	3·78	7·24	2·93	2·50	3·60
March	4·21	4·71	4·31	4·15		2·31	2 56	7·38	1·35	1·18	2·50	6·46	5·81	4·53
April	·40	·15	·67	·86		3·83	2·37	0·79	1·76	1·48	1·14	3·61	3·36	2·79
May	0·45	·50	1·50	1·33		0·66	0·75	0·30	0	0	0	0·22	0·00	0·08
June	Nil.	Nil.	Nil.	·02		0·11	0·11	Nil.	0·17	0·17	0·25	0·20	0·21	0·00
July	Nil.	Nil.	Nil.	Nil.		·37	·40	0·41	0·66	0·59	0·69	0·00	0·80	0·00
August	·15	Nil.	0·16	Nil.		0·03	0·00	0·00	1·47	1·37	1·55	0·23	2·11	0·38
September ...	·21	·39	0·43	·59		1·93	1·82	2·09	0	0	0	1·50	1·93	0·94
October	2·76	3·29	1·08	·89		2·88	2·83	2·25	2·17	2·01	3·31	5·20	4·86	3·55
November ...	2·08	2·19	2·55	1·90	1·80	2·21	2·09	1·39	8·33	7·97	5·11	3·86	3·93	3·43
December ...	2·76	5·96	4·33	3·67	3·61	4·18	3·99	4·65	3·37	3·02	2·92	4·29	4·46	3·73
Totals ...	24·06	28·45	27·82	24·23		27·95	26.34	24·70	31·94	29·66	30·70	34·18	35·08	27·94

NOTE.—The rain gauge at Zuurbekom is a 5-inch gauge; the gauges at the other stations are 8-inch gauges.

GAUGINGS OF STEENKOPJES SPRING.

TAKEN BY T. STEWART, 1896.

Date of Reading.	Average per day.	Total.
November 14th	13,336,000	Very little rain.
„ 15th	15,336,000	
„ 16th	Do.	
„ 17th	Do.	
„ 18th	Do.	
„ 22nd	...	Heavy thunder-storm.
„ 23rd	20,298,200	Spruits still in flood.
„ 25th	16,610,400	Heavy thunder-storm.
„ 27th	16,610,400	
December 1st	16,275,600	
„ 2nd	16,275,600	

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G. 2.

GAUGINGS OF KLIP RIVER AT OLIPHANT'S VLEI (JACKSON'S) AND OF STEENKOPJES SPRING.

TAKEN BY T. STEWART, 1896.

Date of Reading.		Average per Day.		Total.
October 2nd 1896.	October 1-5th	3,377,500	5th	16,887,500
8th	6-11th	2,447,000	9th	22,023,000
20th	15-26th	1,860,500	12th	22,326,000
27th	... ...			18,612,500
November 5th	28-31st	3,497,000	4th	13,988,000
		TOTAL FOR MONTH ...		93,837,000
October.		AVERAGE PER 24 HOURS ...		3,027,000
November 5th	November 1-8th	3,497,000	8th	27,976,000
12th	9-21st	5,443,500	13th	70,765,500
December 1st	22-30th	3,096,500	9th	27,868,500
		TOTAL FOR MONTH ...		126,610,000
November.		AVERAGE PER 24 HOURS ...		4,220,000
December 1st	December 1-14th	3,096,500	4th	12,386,000
8th	4-12th	3,402,000	8th	27,216,000
15th	13-18th	4,000,500	6th	24,003,000
22nd	19-25th	7,340,500	7th	50,683,500
29th	26-31st	9,232,500	6th	55,395,000
		TOTAL FOR MONTH ...		169,683,500
December.		AVERAGE PER 24 HOURS ...		6,473,500
September 9th	September 1-13th	6,631,000	13th	86,203,000
17th	14-20th	5,443,700	7th	38,106,000
24th	21-30th	2,498,700	10th	24,937,000
		TOTAL FOR MONTH ...		149,246,000
September.		AVERAGE PER 24 HOURS ...		4,974,800

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Appendix G.

Mr. T. Stewart and Mr. T. Raynes

G. 3.

Statements with regard to pumping capacity of stations and capacities of reservoirs, together with other statistics supplied by the Johannesburg Waterworks, Estate and Exploration Company.

PUMPING CAPACITIES OF STATIONS.

ZUURBEKOM.—

At present, one set engines triple expansion and pumps capable of delivering one million gallons per day, to be shortly duplicated, and a third set added immediately after.

Present stand by one special steam pump, capable of delivering half a million gallons per twenty-four hours.

Sufficient boiler power in course of erection.

PAARLS-HOOP.—

Intermediate Station.—Two sets of Worthington Triple Expansion Engines and Pumps, capable of delivering one million gallons each per day, to be shortly reinforced by two similar sets.

Sufficient boiler power on hand to work the Station efficiently.

WELTEVREDEN.—

Two sets of engines and pumps similar in all respects to Paarls-Hoop Station.

TOWN STATIONS.—

No. 1.—Two steam pumps, capable of lifting 275,000 gallons per day, driven by two semi-portable boilers.

No. 2.—One duplex steam pump, capable of lifting to No. 1 Reservoir 300,000 gallons per day, driven by two semi-portable boilers.

No. 3.—One compound engine geared to pumps, capable of lifting to No. 1 Reservoir 480,000 gallons per day, driven by one Babcock & Wilcox Boiler.

No. 4.—One duplex steam pump, capable of lifting 428,000 gallons to No. 1 Reservoir, driven by one semi-portable boiler.

No. 5.—Two compound duplex steam pumps, capable of lifting together 856,000 gallons per day to No. 1 Reservoir, driven by two Babcock & Wilcox Boilers.

CAPACITIES OF RESERVOIRS.

HIGH SERVICE RESERVOIR.—

Built in stone and mortar.
Two compartments, 1,500,000 gallons each.
Total capacity, 3,000,000 gallons.

LOW SERVICE RESERVOIRS.—

No. 1 Station.—Built in stone and cement with open springs and filter bed.
Capacity, 1,213,000 gallons.

No. 2 Reservoir.—Covered, built in brick and cement.
Capacity, 400,000 gallons.

No. 3 Reservoir.—Open, sides pitched six-inch stone.
Capacity, 21,600,000 gallons.

No. 4 Reservoir.—Open, sides pitched six-inch stone, with puddle apron to bottom bank.
Capacity, 12,500,000 gallons.

No. 5 Reservoir.—Open, sides pitched six-inch stone.
Capacity, 7,300,000 gallons.

PAARLS-HOOP RESERVOIR.—

Cooling Pond.—90 × 90 × 18. Capacity, 910,275 gallons.
90 × 90 × 10. Capacity, 500,000 gallons.

These Reservoirs have open bye passes built with stone to carry off surface or drainage water.

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YIELD AT STATIONS FOR SIX MONTHS ENDING JULY 2ND, 1897.

NO. 1 STATION.—

3,983,670 gallons for half-year.
153,209 gallons per week.
21,887 gallons per day.

NO. 2 STATION.—

46,290,243 gallons for half-year.
1,780,394 gallons per week.
254,342 gallons per day.

NO. 3 STATION.—

21,251,140 gallons for half-year.
817,348 gallons per week.
116,764 gallons per day.

NO. 5 STATION.—

52,429,108 gallons for half-year.
2,016,504 gallons per week.
288,072 gallons per day.

WELTEVREDEN.—

93,646,544 gallons for half-year.
3,601,787 gallons per week.
514,541 gallons per day.

YIELD AT STATIONS FOR SIX MONTHS ENDING DECEMBER 30TH, 1897.

NO. 1 STATION.—

1,259,850 gallons for half-year.
48,454 gallons per week.
6,922 gallons per day.

NO. 2 STATION.—

37,719,804 gallons for half-year.
1,450,757 gallons per week.
207,251 gallons per day.

NO. 3 STATION.—

20,778,752 gallons for twenty weeks.
1,038,884 gallons per week.
148,412 gallons per day.

NO. 5 STATION.—

34,276,151 gallons for half-year.
1,318,310 gallons per week.
188,330 gallons per day.

WELTEVREDEN.—

61,671,666 gallons for half-year.
2,371,985 gallons per week.
338,855 gallons per day.

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Appendix G.

Mr. T. Stewart and Mr. T. Raynes.

YIELD AT STATIONS FOR SIX MONTHS ENDING JUNE, 1898.

NO. 2 STATION.—

31,036,712 gallons for half-year.
1,193,719 gallons per week.
170,531 gallons per day.

NO. 3 STATION.—

25,115,500 gallons for half-year.
965,981 gallons per week.
137,998 gallons per day.

NO. 5 STATION.—

21,750,867 gallons for half-year.
836,571 gallons per week.
119,510 gallons per day.

WELTEVREDEN.—

90,873,966 gallons for half-year.
3,495,152 gallons per week.
499,307 gallons per day.

Hereafter the Town Stations and Weltevreden have not been worked with sufficient regularity to render the statistics obtained to be of any value. They have only been used to make up differences.

ZUURBEKOM.

WATER SENT TO JOHANNESBURG SINCE JULY 1ST, 1898.

Commenced pumping irregularly April 7th, 1898. These returns therefore start with first complete half-year, i.e., *July to December, 1898.*

1898	July to December	122,166,169 gallons.	4,694,852 per week.	670,694 per day.
1899	January to July	142,835,659 gallons.	5,486,871 per week.	776,624 per day.
1899	July to December	146,062,416 gallons.	5,617,785 per week.	802,541 per day.
1900	January to July	96,174,708 gallons.	3,699,027 per week.	528,432 per day.
1900	July to December	125,290,688 gallons.	4,640,396 per week.	662,913 per day.
1901	January to July	129,984,100 gallons.	4,999,390 per week.	714,200 per day.

PUMPING AND DISTRIBUTION.

Year ending June 30th.	Total Gallons Pumped.	Gallons Distributed.	Ratio of Distribution to Pumping.	Daily Consumption.
1893		148,612,000		407,156
1894		164,113,600		449,626
1895	316,163,000	205,505,950 (Estimate.)		560,290
1896	328,627,099	214,243,197	65·2 per cent.	586,967
1897	519,936,050	322,755,352	62·07 per cent.	884,261
1898	530,426,941	275,361,887	51·91 per cent.	754,414
1899	1,092,256,243	426,091,682	39·01 per cent.	1,167,374
1900	794,826,729	262,066,072	32·97 per cent.	717,989
1901	638,315,874	247,868,822	38·83 per cent.	679,092

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DISTRIBUTION TO TOWN.

Each half-year from January, 1897.

1897—January to July ...	152,541,352 gallons.	5,866,975 per week, or	838,140 per day.
July to December...	142,202,817 gallons.	5,469,340 per week, or	781,334 per day.
1898—January to July ...	133,155,570 gallons.	5,121,368 per week, or	731,624 per day.
July to December...	226,444,714 gallons.	8,709,414 per week, or	1,244,202 per day.
1899—January to July ...	198,047,860 gallons.	7,617,187 per week, or	1,088,169 per day.
July to December...	168,988,854 gallons.	6,499,571 per week, or	928,510 per day.
1900—January to July ...	93,077,218 gallons.	3,578,892 per week, or	511,412 per day.
July to December...	109,623,772 gallons.	4,985,528 per week, or	712,217 per day.
1901—January to July .	138,245,050 gallons.	5,120,187 per week, or	731,455 per day.
July to October ...	95,370,750 gallons.	5,610,044 per week, or	801,435 per day.
Seventeen weeks, inclusive.			

Highest week's consumption, October 22 to 29, 1898 ... 13,075,573 gallons.
Lowest week's consumption, June 7 to 14, 1900 ... ... 2,621,386 gallons during war.
Lowest week's consumption, Jan. 27 to Feb. 3, 1898 ... 3,769,519 gallons before war.

CLOSELY POPULATED DISTRICTS IN SUPPLY.

	Stands.	Population (possible).	Leads.		Population (Present).
Bertrams	582	2,910	59		294
Brickfields	1,107	7,749	2	7	14
Burghersdorp	149	1,043	30	7	210
City & Suburban	706	4,236	244	6	1,464
Doornfontein	828	4,115	389	5	1,945
New Doornfontein	828	4,140	239	5	1,195
Doornfontein Gardens	64	320	11	5	55
Fairview and Fawcus	385	1,925	75	6	450
Ferreiras	673	3,365	205	7	1,435
Fordsburg...	987	5,922	18	7	126
Jeppes and Belgravia	2,646	13,230	598	5	2,990
Johannesburg	5,644	28,220	2,119	7	14,833
Marshalls	816	4,080	486	6	2,916
North Doornfontein	96	576	34	6	204
Spes Bona	49	245	9	5	45
Troyeville	687	3,435	157	5	685
Vrededorp	1,285	8,995	8	7	56
Wolhuter	160	990	65	6	390
Wanderers View	112	560	46	5	230
	17,799	96,056	4,794		29,537

Kaffir Locations—stands, 1,726; population (possible), 17,260.
Gold Mining Companies—leads, 40.

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Appendix G.

Mr. T. Stewart and Mr. T. Raynes.

TOWNSHIPS IN SUPPLY SPARSELY POPULATED.

Township.	Stands.	Population (Possible).	Leads at Present.	Population (Estimate).	
Bellevue	607	3,035	7	35	At 5 Persons.
Berea Estate	1,160	5,800	40	200	Per Lead.
Charlton Terrace			5	25	Per Lead.
Highlands	16	80	3	15	Per Lead.
Houghton Estate	115	575	1	5	Per Lead.
Lorentzville	342	1,710	7	35	Per Lead.
Meyer & Charlton	65	325	8	56	7 Persons.
Park Town			5	25	5 Persons.
Yeoville	1,192	5,960	35	175	5 Persons.
	3,497	17,485	111	571	

TOWNSHIPS NORTH OF REEF 1 ONLY IN SUPPLY, VERY SPARSELY POPULATED OR NOT AT ALL, BUT CLOSE TO PRESENT SUPPLY MAINS.

Township.	Stands.	Population (Possible).	Leads. at Present.	Population (Estimate).	
Auckland Park	232	1,160			
Bellevue East	502	2,510	Future Probable Leads.	Future Probable Population at 5 Persons per Lead.	At 5 Persons per Stand.
Claremont	784	3,920			
Judith's Paarl	377	1,885			
Richmond	223	1,115			
	2,118	10,590	2,000	10,000	

TOWNSHIPS SOUTH OF REEF AWAY FROM PRESENT SUPPLY MAINS, BUT LIKELY TO COME INTO SUPPLY, NOW MODERATELY POPULATED.

Township.	Stands.	Population (Possible).	Leads at Present.	Population (Estimate).	
Booysens	180	900			
Daviesville	95	475			
La Rochelle	576	2,880			
Oakleigh	104	520	Future Probable Leads.	Future Probable Population at 5 Persons per Lead.	At 5 Persons per Stand. Leads at Proportion of 1 to 1½ Stands.
Rosettenville	1,665	8,325			
Turffontein	2,506	12,530			
West Turffontein	83	415			
Ophirton	425	2,125			
	5,634	28,170	3,756	18,780	

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APPENDIX H.

Notes by Mr. A. Karlson, City Engineer, Pretoria.

H 1.—General Note on Water Supply for the Rand and Johannesburg. (Printed.)

H 2.—Map of the Transvaal South of the Rand with indications of the different Projects. (Not printed.)

H 3.—Project of pumping twenty-two million gallons daily to the Rand and to Johannesburg from the Vaal River at Vereeniging. (Extracts printed.)

H 4.—Project of pumping twenty-two million gallons daily to the Rand and to Johannesburg from the underground water in the Klip River Valley. (Extracts printed.)

H 5.—Note on the Wonderfontein Scheme. (Extracts printed.)

H. 6.—Note on the Rainfall and the small quantity of water retained. (Extracts printed.)

H. 7.—Supplementary Notes on Rainfall, Absorption, Filtration, Galleries, &c. (Not printed.)

H. 8.—Note on Ownership of Springs and Underground Water. (Not printed.)

H 9.—Note on levels of the dolomite formation from the Eye of the Mooi River to Vereeniging, passing through the valleys of the Wonderfontein "Loop" and the Klip River. (Extracts printed.)

H 10.—Note on the Expenses of Pumping and on the latest improvement of the Steam Engine. (Not printed.)

H 11.—Note on Gaugings of Rivers and Streams. (Not printed.)

H 12.—Note on Water required in a Modern City. (Not printed.)

H 13.—Note on the recovery of Second Canalisation for the supply of Johannesburg with a second-class water consisting of purified and sterilized Sewage. (Not printed.)

H 14.—Note on the composition of the water from the dolomite formation in Pretoria. (Not printed.)

H 15.—Note on the purification of Sewage and water. (Not printed.)

H 16.—Report on the advantages and disadvantages of the Liernur Pneumatic Sewer and Liernur Horizontal Sewer, comparing these systems with the separate Gravitation Sewer. (Not printed.)

H 17.—Note on Lavelloi's Peret Pneumatic Sewer. (Not printed.)

H 18.—Note on Sewage Lift. (Not printed.)

H 19.—Note on the Ventilation of Sewers. (Not printed.)

H 20.—Supplementary Note on the Liernur Sewage System, on the Gravitation Sewer and on the best system for Johannesburg. (Not printed.)

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Appendix H.

Mr. A. Karlson.

H 1.

General note on water supply for the Rand and Johannesburg.

Having had occasion to study the water supply to the Rand a few years ago, I have the honour to submit to you some projects on this question, which projects are, however, only to be considered as indications to the way in which I consider that this important question should be approached.

Several projects for the water supply to the Rand have been proposed:—

1. The Vaal River.
2. The Zuurbekom.
3. The Wonderfontein.
4. Large dams in the Klip River and Natal Spruit.
5. Underground Supply from Klip River.
6. Supply from Zuikerboschrand River.
7. Supply from the basin of the Crocodile River.
8. Supply from the basin of the Six Mile Spruit.

In this Report I have treated the Vaal River Scheme, the Underground Klip River Schème and the Wonderfontein Scheme.

Of the others the Zuurbekom will be insufficient for Johannesburg alone when the underground strata are emptied.

The large dams in the Klip River should be built on the dolomite formation and this will only cause an increase of the lower springs. A permanent supply could not be derived from there.

The Zuikerboschrand River supplies the Heidelberg District and ought to be left for that district. Besides the formations are not dolomite, and a large supply would be very uncertain.

The supply from the valley of the Crocodile, of which one part is in the dolomite formation, is possible, but this formation is not very extensive there, consequently the supply as regards quantity would not be quite certain. The dolomite formation is also very probably deep there, so that an artificial infiltration would not have sufficient effect.

The supply from the basin of the Six Mile Spruit is altogether out of the question because this basin is already supplying Pretoria.

There are therefore, only three left:—

1. The Vaal River Scheme.
2. The Klip River Scheme.
3. The Wonderfontein Scheme.

The quantities required for the mines were given three years ago at 22,000,000 gallons daily, and my two projects of the Klip River and Vaal River Schemes made up three years ago were based on this figure. With the latest perfections in the mining plant this figure may be too large, but the population along the Rand (Johannesburg not included) must also be considered. In that case the above quantity may even be too small.

For Johannesburg the quantity required has been estimated by me for a population of 100,000 inhabitants at 11,200,000 gallons daily, of which only 5,600,000 need be new water, the supplement would be derived from the purified sewage which must be distributed in a second pipe-net.

In order to estimate the quantity of water required for Johannesburg, I have been obliged to enter into the whole question of sanitation:—

(1) To show that the only possible system is a separate water-carriage sewer.

(2) To prove that the Sewage can be so thoroughly purified that it can be distributed in a second pipe-net.

In connection with these, such secondary questions as sewage lift and sewer ventilation had to be discussed.

But in connection with the sewage purification I have described all the different ways of purifying sewage and water industrially, and this monography gives these methods so far as science actually knows them.

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However interesting all these questions may be, they are only secondary to the principal one, which is the source from where the water supply should be derived.

Three years ago it was impossible to deal with the Vaal River as it was a limit between two different countries and interested a third. At present it still interests three Colonies under different Administrations and under different laws.

The difficulty of taking out a large quantity of water may, if not impossible, as previously, still be of very great importance. The quantity of water in the Vaal is by no means as large as it is generally believed to be. I have measured the stream in Standerton and there it had a discharge of only 18,500,000 gallons per 24 hours. But several other streams join the Vaal below Standerton, and by proportion of the drainage areas I arrived at 101,000,000 gallons. This is, however, an absolute maximum, and it is most likely that the stream is very much smaller. For a combined scheme for the Rand and Johannesburg we need 27,000,000 gallons. This is, therefore, a very large proportion of the discharge of the Vaal at the lowest level.

Any increase in the discharge of the Vaal by means of large dams in the river bed, is hardly possible, because the river bed is already too small and the banks flooded for miles during an exceptional flood.

The Vaal River could, therefore, scarcely be contemplated for a combined water supply to the whole Rand.

The Wonderfontein gives a very remarkable supply, and is supposed to give between 20 and 30 million gallons daily. The uncertainty of the figure is due to various causes of which the gaugings in themselves may be the greatest cause. This is explained in one of the Notes. The small distance from the spring to the principal source of it will also certainly be a strong reason for the variation in the discharge.

The Wonderfontein Scheme has the great disadvantage of taking the water away from the Mooi River and the expropriation of large agricultural water-rights will be very expensive, and always a very bad policy in a country where the agriculture will ultimately be the backbone of the country.

In a special Note* on Ownership of Springs and Underground Water I have given all the different laws and leading cases on the subject, which I hope, will shape this question in its true light. The Town of Potchefstroom also exists by the Wonderfontein Springs, and by taking away these springs or the underground sources supplying these springs the town of Potchefstroom would be ruined.

In my Note on the Wonderfontein Project† I have indicated the different arrangements for the increase of the supply which will have to be taken in case the Wonderfontein Project is adopted. These different arrangements should be absorption dams in the Wonderfontein "Loop" from Luipaardsvlei to Blaauwbank, an artificial absorption lake on the farm "De Pan," and a large dam at Frederikstad in the Mooi River.

If the expenses for this project, which will be heavy enough, are not considered excessive, this project is, I consider, the most certain of all.

The Klip River Scheme is based entirely on an artificial underground supply. Absorption dams are established where it is possible in the Klip River and Riet and Natal Spruits. A large number of small wells are bored down in the dolomite formation from these artificial lakes, and all the figures derived from experiments on absorption show that it is quite possible to store underground so much water that it is sufficient for the whole supply.

The collection of this water should be made in 22 wells with galleries sunk in the Klip River valley between Klip River Station and Vereeniging or in a general gallery built on the whole length between these two points.

In order to save expenses in pumping, two central electric stations have been projected supplying the power to all the pump stations. One of these electric stations should be at Vereeniging where the coal is to hand, and the other at the Klip River range on a spot to which the Railway could easily be built.

The exact place of the wells or of the gallery must be fixed only after careful hydrographic studies, but I believe that the best position is as I have indicated them.

As a supplementary supply an artificial permanent lake could be established in building a large dam in a poort of the range South of the Klip River. This lake should be on the shale formation and no considerable loss by infiltration need be feared. This project has the great advantage that no legal difficulties will or can arise, and that it can be very rapidly put into execution.

In my different notes I have tried to demonstrate as well as I can the uncertainty of the actual underground supply, and I have shown by statistics from other countries that such a supply can be good for several years and then fail entirely.

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* Not printed.

† See Appendix H 5.

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Appendix H.

Mr. A. Karlson.

In the accessory notes I have dwelt at some length on the constant danger of pollution of springs and underground water, and if my absorption wells can be criticised from this point of view, they do not constitute a very great additional danger, and if the question should be of a combined water supply, I would absolutely insist on the sterilization of the drink water supply by ozone which, undoubtedly, will now be possible at a half-penny per 1,000 gallons.

In the small mining centres or on the mines supplementary home filtration through asbestos filters, well surveyed by a sanitary inspector, would be sufficient.

On the question of contamination by underground percolation or on the question of simple or more rapid underground communication, I have shown that such communication as well as its velocity can now be exactly and very rapidly determined with the help of the levure of beer.

I trust that these summary studies of this very difficult problem will be of some use to you, and that my studies in throwing more light on the question, will contribute to the ultimate solution of this problem.

Pretoria, 13th December, 1901.

H 3.

Project for a supply of twenty-two million gallons of water daily from the Vaal River at Vereeniging to Johannesburg and the Rand. (Report made in 1899.) (Extracts printed.)

QUANTITY OF WATER IN THE VAAL RIVER.

All information about the discharge of the Vaal at lowest flood level is very contradictory and varies from simple to double or even more.

Having measured the discharge of the Vaal at Standerton, I found there 0·970m³ per second at the lowest level known, but the River drains at this place only an area of 8,680 square kilometres, whereas at Vereeniging it drains 48,000 square kilometres, through rivers all coming, either from the Rand or from the Drakensberg, as the Vaal itself. Of this drainage area 22,000 belongs to the Transvaal, and 26,000 to the Free State, so that in any case not more than one-half of the water belongs to the Transvaal.

By proportion the discharge of the Vaal at Vereeniging should be

$$\frac{48{,}000}{8{,}680}\ 0{\cdot}95\text{m}^3 = 5{\cdot}300\text{m}^3 \text{ per second}$$

or about 101,000,000 gallons per 24 hours. This is maximum and there is great chance that there is much less.

This is very much less, then, than it has been stated by interested parties. However, if we admit this quantity, 50,000,000 belong to the Transvaal, and it should not be impossible for the Government by a special law to authorise the taking out from it of the necessary 22,000,000 gallons. There would still remain for the Transvaal side 28,000,000 gallons. 55 miles below Vereeniging the Vaal receives the tributary, Mooi River-Wonderfontein "Loop," which alone brings over 30,000,000 gallons. (30,000,000 gallons is the measured quantity of the Wonderfontein alone). I admit the difficulty in taking such a great proportion out of a public stream, but this has been done in other countries and the riparian owners have been obliged to accept the inevitable.

(Here follows a detailed estimate of the cost of supplying 22,000,000 gallons per diem, showing a total capital expenditure of £1,320,000 and annual maintenance charge amounting to £191,566)

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The daily expense would then be £525, and per 100 gallons 0·575d. or say *6 pence per 1,000 gallons.*

H 4.

Project of a supply of twenty-two million gallons or more daily from the underground stream in the Klip River Valley to Johannesburg and the Rand. (Report made in 1899). (Extracts printed.)

GENERAL CONSIDERATIONS.

The principal and absolute condition of such a water supply is that it must never fail for a day. The consequence would be partial stoppage of the mines. In such a case a project based on an underground stream of which the quantity is unknown must take into consideration a co-efficient of security, such that there can

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be no doubt of a constant success even after years of pumping. A limited project based on the quantities that certain existing wells now are giving might after two or three years' time absolutely fail, because it is very likely that in the underground stream certain reservoirs are formed and after a few years tapping those will be exhausted, and the infiltered part of the natural and annual rainfall will be the sole quantity there will be to rely upon. A possible change of project after a short time would be disastrous, and it is certainly better to draw up from the beginning a larger scheme notwithstanding that the expense of such project would be much greater.

GENERAL LINES OF THE PROJECT.

This underground stream exists under the dolomite formation inside the Black Reef. It is not probable that the Thalweg of the underground stream corresponds with the bed of the Klip River. It is certainly to the West of the River bed and a few borings will soon determine its probable course. If a system of wells are sunk in the Thalweg of this underground stream from the farm Zwaartkoppies to near Vereeniging the underground water of the whole of the dolomite formation can be collected, and this underground stream would be fed from the rainfall of the whole space between the Rand and the Vaal River.

For the purpose of still increasing the underground stream, I should suggest that small dams be constructed in the upper parts of Klip River, Natal Spruit and Riet Spruit where the dolomite formation is well determined. In these small artificial lakes a certain number of bore-holes should be sunk so that the rainfall collected by these dams would rapidly be filtered into the underground stream. Such wells, called "boit tout," have been very successfully used in France for the drying up of swamps. Mr. J. Dumas, of Valence, has already proposed to construct such dams and wells in an absorbing ground for the purpose of stopping the rainfall from flowing direct to the sea, and to collect this water underground naturally filtered.

The total drainage area from which the considered underground stream should be supplied is not less than 860 square miles or 2,227 square kilometres.

The total annual mean rainfall can with safety be estimated at 25 inches or 635 millimetres so that the total volume of water fallen on this area should be in one year 2,227,000,000 x 635 = 1,414,145 million litres = 311,500 million gallons.

The total quantity required would be 22 x 365 = 8,030 million gallons, or 2·5 per cent. of the whole rainfall.

But of the above area of 2,227 square kilometres only 743 are on the dolomite formation which is really the absorbing ground.

According to measurements, in the North of France about 300 square kilometres of absorbing ground is required for a discharge of the springs of one cubic metre per second, so that for 743 square kilometres the total discharge in a year would be

$$\frac{743}{300} \times 86{,}400 \times 365 \times \frac{1{,}000}{4{\cdot}54} = \frac{17{,}204}{\text{Million Gallons.}}$$

This is double the required quantity, but we have no experience here how great an area of absorbing ground will be required for one cubic meter per second. In the dolomite formation it is also more difficult than in a gravel formation to collect the whole stream. Therefore, if the small dams were constructed in the Klip River, Natal Spruit and Riet Spruit a great part of the large rains from an area of 900 square kilometres would be collected. Admitting that only 2 inches rain from this area is collected and absorbed by the wells in the artificial lakes, a quantity of water of

$$\frac{900{,}000{,}000 \times 0{\cdot}05 \times 1{,}000}{4{\cdot}54} = 10{,}000 \text{ mlilion gallons}$$

should during the rainy season be absorbed, and as this water comes from the furthest points the regularity of the underground stream should in all seasons be secured.

I have no doubt, that this scheme will give very much more than the 8,000 million gallons yearly, but, as said before, this must be a scheme for which no failure is possible, and therefore, it is necessary to multiply the co-efficient of security.

The whole scheme does not necessarily need to be executed at once, and, during construction, time will show the true hydrography of the district which is now an unknown factor and for which there is no time for thorough investigations. If, as is possible, more water is found than is necessary, the whole of the Klip River valley can be put under extensive cultivation and more than compensate for the cost of expropriation of the ground. Townships will rise besides the existing ones which also will need to be supplied, and in the twenty-two million gallons of water which would

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Appendix H. Mr. A. Karlson.

in the future be required nothing is calculated for the Rand Townships. If Johannesburg had not been supplied from Zuurbekom or from Wonderfontein it is certain that a combined scheme of this nature was what was necessary, and it is to be regretted that it was not suggested a long time ago.

One difficulty rises which is the acquisition of the ground. Whole farms are not absolutely necessary, and for a scheme such as this and in any country its execution would not be possible without an expropriation law.

The Government must, therefore, assist in declaring the project of public utility and so make it possible for the new company to expropriate the ground at a reasonable price.

The wells should be one mile distant from one another so that from the farm Zwaartkoppies to Vereeniging there would be 22 wells with galleries or series of wells. Each series is supposed to give 1,000,000 gallons per twenty-four hours. This is not more than can be obtained from actual borings.

The power for these 22 pump stations should be supplied from a central electric station at Vereeniging for the purpose of saving labour and transport of coal. The difference in level is about 197 feet = 60 metres.

From the Zwaartkoppies to Johannesburg the distance is 14 miles = 22,400k. and the difference in level about 872 feet = 266m.

It would scarcely be economical to transfer the necessary power for the lifting of 22,000,000 gallons to a height of 326m. over such a long distance on 34 kilometres, but it probably would be economical to have at the Zwaartkoppies (or, better, half-way to Johannesburg) a second electric central station, and then three more pump stations between this place and Johannesburg for the purpose of avoiding a greater pressure than 70 metres on the pipes and a greater thickness of plate than 9 millimetres.

A special railway for coal transport would then only be needed on the Zwaartkoppies for a short distance.

(Here follows a detailed estimate of the cost of supplying 22,000,000 gallons per diem, showing a total capital expenditure of £1,450,000, and an annual maintenance charge of £225,574.)

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The daily expense would then be £618, and per 100 gallons the price would be 0·675d. or say per 1,000 gallons 7 pence.

H 5.

Note on the Wonderfontein Scheme. (Extracts printed.)

On the two farms Wonderfontein Nos. 653 and 685 very large natural springs rise to the surface.

They are produced by two long dykes vertical to the Wonderfontein "Loop." The first on the farm 685 intercepts all the water from the dolomite formation on the farm Blaauwbank and the farms above to Luipaardsvlei and Zuurbekom. The second dyke passes through the interruption of the Black Reef series and the water from the dolomite formation on the high water-shed is undoubtedly running along this dyke until it reaches the surface at Wonderfontein. The large quantity of this spring is explained by the presence of large pans on the farms Doornfontein, Wildfontein and "De Pan." This last has very large dimensions and a quantity of water is collecting there to be absorbed by the dolomite and brought down to the Wonderfontein along the dyke. This is only a distance of 7½ miles = 12 kilometres, and I would not wonder that the discharge of the spring increased considerably somewhat at the end of the rainy season, and that it is even very doubtful if this water is entirely pure, seeing the origin of the source is so near. This may also explain the enormous differences in the gaugings of this spring, varying from 20 to 30 million gallons per day. Part of this difference may, however, be attributed to the application of different formulas as explained in another note.

In any case the pan is the whole secret of Wonderfontein and this pan proves the absolute correctness of my theory on the absorption dams.

In case it is decided that a limited supply of 5,000,000 gallons should be taken from Wonderfontein there is no difficulty whatever, to increase the Wonderfontein with this quantity, so that the quantity of water in the Wonderfontein "Loop" and the Mooi River is not decreased. We must, as a matter of fact, always remember that the underground stream between Wonderfontein and Turffontein will be proved and that if this stream is not proceeding by percolation it is legally impossible to touch the Wonderfontein without intercepting the water along the dyke, but this stream is very likely neither "filtration" or "percolation." Besides, the policy of taking the water away from the agriculture would be entirely wrong especially as it is just this valley

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which, through the easy railway communication, is destined to supply the Rand with the necessary grain. The agriculture there will be very much more developed than it is at present and every drop of water will be needed. Besides we must remember, that the large and growing town of Potchefstroom is entirely dependent on, and exists, from this water supply.

If, then, as said, 5,000,000 gallons are to be taken from Wonderfontein this quantity must be artificially replaced. Absorption dams for this purpose can be built in the Wonderfontein Loop from Luipaardsvlei to Blaauwbank and the dyke on Wonderfontein, No. 685, will, undoubtedly, intercept it all. Together with the water at present coming out below the farm Blaauwbank on Wonderfontein No. 685, this will very likely be sufficient to form 5,000,000 gallons, and the water could be pumped from this point instead of from the lower farm Wonderfontein and a distance of about 5 miles = 9 kilometres would be saved.

But besides this the Wonderfontein itself can be widely and very simply increased. A small spruit coming from the crystalline rocks on the farms Witfontein and Doornfontein with a drainage area above the pan of 25 square miles = 64 square kilometres is now flowing down to the Wonderfontein Loop. Small springs also exist in this spruit.

A small dam in this river will very likely throw all the water into the pan and as at least 70 per cent. of the rain water from the granite formation will flow down, we will get a supplement of 0·70 x 25 inches x 0·0254 metre x 64,000,000 = 28,448,000 cubic metres = 6,270 million gallons corresponding to a daily supply of no less than 17,000,000 gallons.

If the pan could contain the larger quantity of this water the infiltration may be so slow that the spring would be constant, and the whole supply for the Rand be derived from this pan and the others to which also other streams may be diverted.

By the short distance to Wonderfontein this constance is, however, not probable. Infiltration wells in the pan may only lead to precipitate the water to the springs. In any case, there is no doubt that this collecting of the water in the pan will be sufficient to more than compensate for the loss of the water taken out for the supply of Johannesburg town, especially if the system of double canalisation as proposed by me is adopted, and to make this Wonderfontein scheme possible. Without it, the value of the Wonderfontein scheme is in my opinion absolutely problematical.

But the point is, if, when there is a question of a combined supply of upwards of 30,000,000 gallons per 24 hours, it could be conformable to the general economic rules of taking 5,000,000 gallons separately at a distance of 40 miles = 64 kilometres, with separate machinery and separate personnel. I think this very doubtful.

But it is possible to take the whole supply from Wonderfontein.

As said, existing gaugings are uncertain, but with the above proposed increase of the Wonderfontein by judiciously placed absorption dams in the Wonderfontein Loop from Luipaardsvlei to Blaauwbank, and by diverting the streams into the Pan, it is certain that a supply of upwards of 30,000,000 gallons or more per day can be obtained.

This would be sufficient also for the farms which have actually the water-rights along the Wonderfontein lake to Welverdiend.

Above the underground stream, 12 miles = 19 kilometres, between the Wonderfontein and Turffontein absorption dams should be built with absorption wells, and in order that this water shall not run away directly through this comparatively large underground channel, the eye of the Mooi River should be blocked up so that only a certain fixed quantity should be let out. sufficient for the irrigation from Turffontein to Fredrikstad.

At Fredrikstad we meet the shale formation. It will then be possible to construct a large masonry dam without any fear that the water would pass through the rock below the dam. This artificial lake should be so large that it could contain a quantity of water corresponding to that which is actually flowing in Wonderfontein.

This is naturally an expensive work, but it is, as far as I can see, the only solution of the problem.

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With the cement imported free of duty, I consider that for such large work for which so much machinery and native labour can be employed the concrete ought to be made for £2 10s., or even less including excavation.

At £2 10s. the total cost will be 321,100 x £2 10s. 0d. = £800,000.

As the other expenses for pipe-line, machinery, etc., are about identical with those of the Vaal or Klip River Scheme, this Wonderfontein Scheme will then be considerably more expensive than the others even if for the Klip River Scheme a general gallery on the whole length from Klip River Station to Vereeniging should be necessary.

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The Wonderfontein Scheme has, however, a much greater guarantee of success as there is no uncertainty about it at all.

The slopes of the sides may be a little steeper, 0·02 per metre, and the foundation may not have to be 8 metres deep all over.

As regards the capacity of the lake I cannot think that it can be much reduced.

A dam of earth at this place and of this height would be too dangerous.

In any case a complete study of this project with the necessary survey seems to me to be absolutely necessary.

H 6.

Note on the Rainfall and the small quantity of water retained. (*Extracts printed.*)

The rainfall for the last eight years has varied from 39·51 inches in 1893 to 20·88 inches in 1899 with an average of 26·53 inches. In millimetres expressed this would mean 994·5 millimetres maximum in 1893, 530·4 millimetres minimum in 1899, 673·9 millimetres mean value for the eight years.

However, these maximum rainfalls have a very slight influence on the water collected underground because the heavy rainfall all comes down in very short times. as, for example, in February, 1893, in less than 12 hours the total height was 4·68 inches, or 118·9 millimetres. That is 12 per cent. of the whole year's rainfall. Of this even the dolomite formation had not time to absorb any quantity. Four such showers will, therefore, bring direct to the sea 50 per cent. of whole year's rainfall.

On the third November last with a rainfall of 46 millimetres in 1½ hours, the Aapies River, coming nearly entirely from the dolomite formation, was in flood within half-an-hour, and this flood lasted for several hours during the night.

The Skinner Spruit was in flood at Daspoort within even less time and, if 46 millimetres rainfall in 90 minutes corresponds to a quantity of 8·52 cubic metres per second and square kilometres, the discharge of the river with such flood, corresponded to 4 or 5 cubic metres, and the flood lasted for quite 2½ hours.

February, 1894, was not an exceptional month. During the whole month we had 3·8 inches = 96·5 millimetres. However, the Vaal that month rose to a few centimetres from the girders of the Vereeniging bridge.

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The whole drainage area of the Vaal above Vereeniging is 48,000 square kilometres.

In supposing a flood of only three days we would have in these three days 2,280,000,000 cubic metres.

(Note.—The flood had not during the whole time this intensity but it lasted longer than three days. Further information gives that the flood lasted over ten days and it was at the height of the bridge for one-and-a-half days.)

This quantity corresponds to a rainfall of

$$\frac{2{,}280{,}000{,}000}{48{,}000{,}000{,}000} = 47{\cdot}5 \text{ millimetres.}$$

That is the half of the whole month's rainfall. In this way it cannot be considered that more that the half of the rainfall is retained by the ground and instead of a mean rainfall of 26 inches we have to calculate upon only 13 inches or 330 millimetres.

We know, besides, that the evaporation is quite during the summer months 120 millimetres per month, that is, 4 millimetres per day. (In Paris in July the evaporation exceeds 100 millimetres. See Angot, page 174.)

For 87 rainy days the evaporation and absorption by the vegetation will then be 4 x 87 = 348 millimetres.

After deduction of the water entirely lost by going direct to the sea, we have only left 13 inches or 330 millimetres, so that there is nothing left at all.

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These calculations may be exaggerated, and are of course so, because large natural springs exist, but they prove sufficiently how important the observations of the streams are, to be able to really judge in this important matter.

It proves also how important it is to collect the rainfall by every possible means, and how great a proportion of the useful rainfall is represented by a supplement of only 2 inches or 3 inches artificially collected. It proves also, that the actual high-water level in the dolomite formation must be considered as being produced by the saturation of the formation since the earth exists in its present form, but that a constant call on this supply in the large quantities which will be required will undoubtedly lead to the exhaustion of the supply within a certain time if means are not taken for replacing this quantity in one way or another.

I do not think that the experiments done up to the present are altogether conclusive. The pumping has only been done on a moderate scale, and the time has not been sufficient to empty the higher situated strata. Besides, the natural filtration by the soil may have been sufficient to compensate for a part of this taken away.

The above calculated figures of 8,800 cubic metres per second for the Vaal for a drainage area of 48,000 square kilometres is not even very great. I have studied the Olifants River in the Low Country, draining there also 48,000 square kilometres, and I have observed one flood of 17,500 cubic metres per second. I did not even consider this to be sufficient, and I calculated the bridge for 22,500 cubic metres, with a security of still five metres to the bottom of the girders for the free passage of the floating trees. This proves how dangerous the Vaal River bridge is and how important it was to have it raised when it was repaired.

H 9.

Note on the level of the water in the dolomite formation from the eye of the Mooi River to the Klip River. (Extracts printed.)

It is very difficult to draw any conclusions from the various information on the height above sea level given from different points of this basin, because no through level from one end to another of the two basins has ever been made.

Generally the railway has been taken as a basis, but the Netherlands level, I regret to say, is very uncertain. We find, in fact, the height above sea level of the

Pretoria Station from Durban by the Natal Railway	1349·30	metres.
" " " Lourenço Marques	1400·40	"
" " " Capetown	1363·65	"
By careful barometric observation over a long period I have obtained	1351·00	"

All the Netherlands Company's levels must then be reduced by 49·40 metres = 162 feet. But considering this great error it is difficult to rely with certainty on their intermediate levels from one Station to another, and one may feel justified in assuming that the levels have been so altered as to correspond with the detail survey plans made by tachometer.

Anyhow, by assuming the intermediate levels to be correct and reducing all the heights above sea level by 49 x 40 metres we will have the more or less exact altitudes of the following points:—

	Metres.	English Feet.
Pretoria Station	1,351·00	4,432·50
Johannesburg, Park	1,738·60	5,704·10
Elandsfontein	1,660·60	5,448·30
Luipaardsvlei Station	1,779·60	5,838·70
Blaauwbank Station	1,521·60	4,992·20
Welverdiend Station	1,472·60	4,831·40
Frederickstad Station	1,425·60	4,677·30
Potchefstroom Station	1,342·60	4,404·90
Natal Spruit Station	1,542·60	5,061·10
Klip River Station	1,487·60	4,880·60
Meyerton Station	1,480·40	4,857·10
Vereeniging Station	1,437·60	4,716·60

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In going out from these points we will have the following levels of water in the dolomite formation:—

	Ground Level.		Water Level.		Intermediate Distance.	Gradient.
	Metres.	Feet.	Metres.	Feet.	Metres.	
Johannesburg, Park	1,738·60	5,704·10				
Edge of the Mooi River or Turffontein about 180 feet below Wonderfontein			1,429·50	4,690·00		
					24,000	0·00226
Wonderfontein Lake			1,483·70	4,869·70		
					3,700	0·00445
Little pool on the Upper Wonderfontein			1,500·10	4,921·70		
					8,000	0·00154
River below Blaauwbank about 30 feet below Station			1,512·40	4,962·00		
					24,000	0·00195
Zuurbekom Waterworks	1,571·30	5,155·10				
Standing Water Level ...			1,559·10	5,115·10		
Suction Water Level			(1,546·90	5,075·10)		
					1,600	0·00163
Klip River Oog			1,556·50	5,106·60		
Melvill Shaft on Olifants Vlei ...	(1,535·20	3,036·60	1,515·30	4,971·60)		
					21,000	0·00215
Klip River 1,500 north of Melvill Shaft			1,511·30	4,958·60		
					3,600	0·0058
Vlei at Shaft on Limit Allewyn's Poort and Zwaartkopjes ...	1,491·00	4,891·80	1,491·00?	4,891·80		
					8,300	0·00133
River at Klip River Station ...	1,487·60	4,880·60	1,480·00	4,855·80		
					17,000	0·000427
Meyerton Station	1,480·40	4,857·10				
					14,000	0·00305
Vereeniging Station...	1,437·60	4,716·60				
For comparison, Fountains, Pretoria			1,375·00	4,511·00		

The distances are only approximate.

This table contains a great deal of very valuable information. It clearly shows that the underground water level has a dividing line, and that this line corresponds with the surface dividing line between the two valleys, on the farm Zuurbekom from where the Johannesburg Waterworks draw their water.

It shows that the gradient on the two sides is almost the same as far as Wonderfontein on one side and Klip River Station on the other, because the level of

	Level.	Distance Kilometres.	Gradient.
Wonderfontein lake is	1,483·70	38,400	0·00197
Zuurbekom Waterworks	1,559·10		
Klip River Station	1,480·00	35,400	0·00226

But from Wonderfontein the gradient continues steep towards the south-west, instead of that from Klip River Station to below Meyerton the fall is very small. This is very important, because a gallery can in such a case be built along the Klip

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River nearly on a horizontal line and it will then draw the water from each side even from under the slate formation. That a fall of the underground water level exists is shown by the levels at Melvill drill shaft on Olifants Vlei where there is a gradient of the underground water level towards the river of 4 metres in 1,460 metres or 0·0027 m. per metre.

The dolomite formation according to Professor Molengraaf lies in beds from 10 to 40 centimetres of thickness horizontally or slightly inclined. With this slight inclination and with the diaclases in the rock, a formation slightly anticlinal towards the river should not be of importance, and if the gallery is sufficiently deep the water will collect therein as well as if the stratification was synclinal.

Towards the Vaal where the fall of the river is steeper it is likely that this gradient vertical towards the River flattens out, and in this case it may be advantageous to bend the gallery across the valley so as to close the outlet to the Vaal. Hydrographic studies will decide on this point.

The most important fact shown by the table is, however, the level at Zuurbekom Waterworks and the level on each side. The underground water level, called by the Manager of the Company "the standing water level," is the highest of the whole basin and the gradient from there to each side is 0·00195 and 0·00163.

It is absolutely evident that from this level a great water supply of any permanency could not be derived. Also on the table of the Waterworks Manager, a suction level figures 40 feet deeper or at a level above the sea of 1,546·90 metres = 5,075·10 feet, and this is only 9·60 metres below the Klip River "Oog." The adjoined sketch* shows that if the whole area situated above the suction level could be included in the area of the wells only a length of 13,800 metres could be interested. This is, however, not possible and hardly more than one-half or 7,000 metres will be interested because the water level takes the parabolic form shown on the sketch. The width of the dolomite formation is 14,000 metres. The whole area included will then be 7 x 14 = 98 square kilometres, and with an infiltration of 10 per cent. of the mean rainfall or 62·5 millimetres, 98,000,000 x 0·0625 x 1,000 = 6,125,000,000 litres = 1,350,000,000 gallons, or per day 3,700,000 gallons. This is of course, an absolute maximum, and it supposes wells on the whole widths of the valley.

The curve of depression is very likely much steeper than I have shown, and the 10 per cent. infiltration is as I have explained in my† "Note on rainfall evaporation and infiltration," an absolute maximum which is very uncertain if it is obtained. All this may bring the permanent supply from such a source down to 1,000,000 gallons, and the only reason, or I may say excuse, for such a project was, as far as I can see, interception of the Klip River under protection of the law, and it is not so absolutely certain that the law in South Africa gives this protection.

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It must also be pointed out that during 9 months no rain falls for replacing the water pumped and during this time the perennial streams will carry away from these "tops" quite as much as is pumped from it.

How much more certain will not a scheme be which is based on taking the water lower down where the whole pressure from above is on the wells, and in which scheme an enormous area can be interested? Numerous absorption dams can be employed for the artificial absorption of the rainfall even from the higher impermeable formation and by the great distance of these absorption dams to the pumping wells the permanency of the supply the whole year round is ascertained. Also in which project the whole scheme is not only not based on the ruination of the lower farmer, but on the farmer's participation in the benefit derived from probable surplus of the water obtained. I know that it is costly in give up a scheme already in work, but when such a scheme is based on such an inadmittable and uncertain basis as the Zuurbekom, and I do not consider that there should be any hestitation on this subject. As this Note specially concerns levels, I may be allowed to recommend a project I have had in my mind since many years.

This is the precise levelling of South Africa.

It must be well understood that this has nothing to do with any ordinary railway surveying of which we have seen the great results in the beginning of this note. This levelling must be made by men who are working under the supervision of a thoroughly scientific man and in using the most modern methods of operating, control, and calculation.

It seems hardly possible that we should not yet know to within 50 metres at what height we are above the sea level. This is worse than any point in Central Africa, where continuous barometer observations have given an approximate height.

* Not printed.

† Not printed.

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Appendix H.

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Even from a purely practical point of view this is greatly inconvenient.

One railway line has one datum and another line an altogether different.

From the scientific point of view any observations of barometric pressure or of temperature is not of any value whatever if the height above the sea level is not known.

As undoubtedly the general survey for the exact topographic of the country must be made before there can be any question of waterworks or irrigation of the country in general, and particularly of this great project for the Rand it is necessary that all over the country bench works with the exact levels should be fixed. So that the general topography can be connected on to these bench marks.

For a high scheme such as the present water supply for Johannesburg and the Rand a small difference of the plan of comparison may not be of importance but complete plans of a large part of the South of the Transvaal have to be made and these plans are costly, and expenses of transforming these plans afterwards to another plan of comparison would be entirely double work.

The very first work to undertake is, therefore, the fixing of maregraphs and medimaremetres along the coast, and the precise levelling on scientifical basis from Lourenço Marques and from Durban to the Rand so that an invariable basis for the whole project can be taken.

Only technical men will understand the importance of this work, but they will unanimously declare that this is even of more importance than the triangulation of the country, and the triangulation must of course previously know the height above sea level at, at least, a few points. I must therefore recommend that this important work of levelling should be undertaken at once.

I entirely agree with Mr. Willcocks that only metric measures should in such a case be used and all others abandoned, so that we can at least be free from all the different measures—metres, English feet, Cape feet, roeden, miles, poles, chains, not to speak about all the different square and cubic measures and the different systems which it will take a man a lifetime to learn.

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APPENDIX J.

Documents referred to by Mr. Schumacher in his evidence on behalf of the Vierfontein Syndicate.

J. 1.

STATISTICS PREPARED BY THE LATE MAJOR L. I. SEYMOUR, SHOWING THE AVERAGE NUMBER OF STAMPS RUNNING, TONS MILLED, DAY'S RAINFALL, AND INCHES OF RAINFALL PER YEAR, FROM 1889 TO 1898 INCLUSIVE.

Year.	Stamps Running.	Tons Milled.	Day's Rainfall.	Total Inches Fell.
1889	711	316,163	59	19·85
1890	1,046	711,877	69	25·94
1891	1,465	1,154,145	99	44·85
1892	1,907	1,979,354	94	29·54
1893	1,955	2,215,413	48	37·69
1894	2,273	2,830,885	105	35·41
1895	2,546	3,456,775	76	29·14
1896	2,386	4,016,697	82	28·23
1897	3,567	5,325,375	77	28·98
1898	4,767	7,331,446	86	27·25

AVERAGE—Day's rainfall, 90·6; total inches fell, 30·166.

It is seen that the average rainfall for ten years has been 30·166, and that during these ten years several companies have, at various times, been stopped for want of water, while there has been apprehension of serious stoppage of many mills owing to a short supply.

The yearly additions to stamping capacity and tonnage crushed show that a much larger supply of water must be provided.

J. 2.

Extract from a letter written by the late Major L. I. Seymour, dated 23rd March, 1899:—

"I take 11,500 stamps as the crushing capacity in 1903-1904."
(This date would now correspond to, say, 1908-1909)

"Five tons crushed per stamp per day is probably under-estimated; therefore, 57,500 tons per day should be crushed by the mines controlled by the Eckstein, Goldfields, Neumann, Farrar Groups.

"From recent data, 306 gallons of fresh water from outside sources must be supplied per ton of ore crushed, but, as the mine water which now makes (with the 306 gallons) a total water consumed on the mines from all sources of 400 gallons per ton crushed, this mine water will bear a less proportion to the total as more tons are crushed.

"11,640 stamps, less 3,230, leaves 8,410 stamps for which the full 400 gallons per ton crushed must be supplied, assuming that the present sources will keep the existing stamps supplied.

"8,400 stamps at five tons per day equals 42,000 tons crushed.

"400 gallons equals 16,800,000 gallons of water required daily.

"Crushing an average of 340 days per year, 5,712,000,000 gallons are wanted, equal to 19,000,000 gallons per day for 300 days.

"42,000 tons × 340 days equals 14,280,000 tons crushed per year more than at present."

J. 3.

Extract from a letter written by the late Major L. I. Seymour, dated 23rd March, 1899:—

"The plant required for this service would be as below, bearing in mind that the main high lift station, collecting and distributing reservoirs, and main high lift pipe line are all completed for their ultimate capacity, as well as offices, quarters, compound, etc., necessary for the final scheme:—

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Appendix J.

Mr. R. N. Schumacher.

PERMANENT WORKS.

Five million gallon collecting earth reservoir	£2,000	
Seven million gallon receiving earth reservoir, Vierfontein	5,000	
28-inch and 12-inch x 54-inch Horizontal Engine and pumps (heavy lift) erected with condensers	8,000	
Vierfontein triple expansion pump and condensers, erected complete at Central Station	12,000	
Engine house and cranes	1,500	
Four 215 horse-power Stirling boilers, erected	6,000	
Boiler house and bunkers	1,500	
General office, quarters, store, boarding house, compound and workshop	4,000	
		£40,000
Seven and a half miles of heavy 28-inch pipe line from Central Station to receiving reservoir	70,000	
Two miles of 28-inch line from receiving reservoir to connect with Rand Mines System	18,000	
		88,000
		£128,000

AUXILIARY WORKS.

Permanent pumping plant at Melville shaft, one million gallons per day, 81 feet high	£2,000	
Permanent pumping plant at Misgund cavern	1,800	
Nine miles light 10-inch pipe line, connecting three caverns with central station	13,500	
		£17,300
		£145,300
Ten per cent. for contingencies		£15,000
Supervision of construction		1,000
Three per cent. engineering fees		5,000
Total probable cost		£166,300

J. 4.

WATER SUPPLY, RAND MINES' SERVICE, FROM OCTOBER, 1898, TO SEPTEMBER, 1899.

Date.	Natal Spruit.	Booysen's.	Knight's.	Simmer East.	Robinson Central Deep.	Village Deep.	Oliphant's Vlei.	Totals.
1898.								
October ...	6,292,800	27,809,000	14,543,500	3,360,200	—	—	—	52,005,500
November...	5,936,400	19,116,000	14,507,600	3,339,800	—	—	—	42,899,800
December...	1,334,700	21,996,000	15,693,900	2,826,800	—	—	—	41,851,400
1899.								
January ...	—	34,451,000	14,479,000	3,683,300	—	—	—	52,613,300
February ...	1,654,400	18,488,200	13,208,000	3,370,500	—	—	—	36,711,100
March ...	3,597,300	34,109,600	15,082,700	3,768,500	—	—	—	56,508,100
April ...	836,800	16,041,000	14,917,700	3,593,100	715,200	—	—	36,103,800
May ...	2,084,100	18,839,200	17,563,600	3,375,300	2,864,800	—	—	44,727,000
June ...	420,000	22,590,300	26,664,400	3,203,100	2,491,000	—	—	55,368,800
July ...	1,139,600	27 962,000	30,829,400	3,295,900	986,700	1,826,800	—	66,040,400
August ...	10,413,800	17,337,200	32,003,100	1,348,000	7,500	2,031,700	3,548,600	66,689,900
September...	10,163,000	16,657,200	40,581,500	1,627,400	—	2,927,800	10,041,600	81,998,500
Totals ...	43,872,900	275,391,700	250,019,400	38,791,900	7,065,200	6,786,300	13,590,200	633,517,600
Average per Month	3,656,075	22,949,308	20,834,950	3,065,992	588,766	565,525	1,132,516	52,793,133

Average per month pumped, August and September, 1898, equals 38,713,950 gallons.

Average per month pumped, August and September, 1899, equals 74,344,200 gallons, or 92 per cent. more than in 1898.

11th November, 1901.

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J 5.

Appendix J.

Circular letter issued by Vierfontein Syndicate to all Mining Companies between the Paarl Central and the East Rand Proprietary Mines.

Mr. R. N. Schumacher.

Private.

VIERFONTEIN SYNDICATE, LIMITED.
Johannesburg, S.A.R.,
21st August, 1899.

P.O. Box 1488.

To the Chairman and Directors,

.....
Johannesburg.

Dear Sirs,—

We are instructed by our Directors to lay the following proposal before you:—

As we believe you are aware, this Syndicate possess and have secured the control of certain water supplies, which it is intended to utilise for the supply of the mines on the Witwatersrand. The permanent works, including the laying of mains (which has been commenced) for so large a scheme will necessarily entail considerable delay, and it is estimated that the time occupied to bring this work to completion will be about two years from date.

It has been found possible, however, to establish a temporary or supplementary supply for the relief of that portion of the Witwatersrand from the Paarl Central, Limited, to the East Rand Proprietary Mines inclusive, which it is believed will overcome any shortfall which may be expected owing to dry seasons. In the meanwhile, we now beg to offer you the opportunity of joining in the temporary scheme.

(1) Your Company would from the 1st September next become entitled to your proportion of the available supply of water based on the number of your stamps in operation or about to be dropped by December 31st, on payment on or before the 1st September to the Vierfontein Syndicate of £10 (ten pounds) per stamp.

(2) Your Company will on the same basis be charged as per meter for the amount of water supplied to you at the actual cost of delivery, plus 6d. per 1,000 gallons. The present cost of delivery is estimated and will be charged at 2s. per 1,000 gallons, which amount will be reduced or raised as circumstances will permit or require, but shall in no case exceed 4s. plus 6d. per 1,000 gallons. This charge would only apply to the supplementary supply, and would not affect your present agreement with the Rand Mines or others.

(3) The Vierfontein Syndicate, whilst having every confidence that the supply of water will prove adequate for above purposes, do not guarantee an unfailing or maximum supply.

(4) The amount of £10 per stamp is estimated to cover the actual cost of the temporary works, and is by no means a source of profit to this Syndicate. Our Directors, therefore, beg to point out that in justice to such working companies as may now agree to our proposal, it will not be possible at a later date prior to the establishment of the permanent scheme to admit such companies to share in the advantages now offered.

The above charges are irrespective of the expense of laying delivery pipes from the nearest convenient point on the Syndicate's main to the point or points at which the consumer desires to have the water delivered on the mine, which delivery pipe must be paid for by the consumer unless it is already in place.

(5) Should your Company wish to join the temporary scheme under the above conditions, which will be embodied in agreement form, your reply is requested on or before the 31st inst., after which date no arrangements can be entered into.

We are, dear Sirs,

Yours faithfully,

(Signed) THE CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LTD.,
per SECRETARIES.

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Appendix J.

J. 6.

Mr. R N. Schumacher.

Statement showing the financial position of the Vierfontein Syndicate, Limited, on the 31st December, 1901.

	£	s.	d.
Vierfontein Dam	56,852	0	0
Oliphant's Vlei, Shafts, Machinery, etc.	32,880	0	0
Rooikop do.	9,730	0	0
Zwaartkoppies do.	1,526	0	0
Pipe Line, Oliphant's Vlei to Booysens	25,585	0	0
28-inch Pipe Fittings	102,629	0	0
Zwaartkoppies Scheme	55,897	0	0
Imports to arrive	11,333	0	0
General Water System	15,672	0	0
Town Stores	2,870	0	0
Interest	10,439	0	0
Rain, Steam and Water Gauging	1,684	0	0
Salaries, etc.	3,624	15	0
Legal Expenses	624	0	0
Consulting Engineer's Fees	1,561	0	0
Travelling Expenses	530	0	0
Furniture, Town Office	672	0	0
Town Stables	273	0	0
Live Stock, Vehicles and Harness	440	0	0
Town Stable Expenses	387	0	0
Drawing Office Expenses	583	0	0
Sundries	901	0	0
General Survey Expenses	1,367	0	0
Expenditure during War period	2,253	0	0
Directors' Fees Nov. 1898 to Dec. 1901 inclusive (Fees £1. 1s. each per meeting attended)	166	5	0
	£340,479	0	0

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APPENDIX K.

Appendix K.

Mr. J. N. de Jongh.

Statement regarding the Vaal River Scheme by Mr. J. N. De Jongh on behalf of the Vereeniging Estates Company.

STATEMENT OF J. N. DE JONGH TO BE SUBMITTED TO THE WITWATERSRAND WATER SUPPLY COMMISSION.

I am Chairman of the Vereeniging Estates, Limited. This Company has a land-holding North and South of the Vaal River of 126,686 acres. The following farms belonging to the Company are situated on the Vaal River, the river being the boundary on one side, viz.:—

ON THE NORTH BANK OF THE VAAL RIVER.

Name of Farm.	*Extent.*
Zoekfontein	2,645 Acres.
Vischgat	3,875 „
Pantfontein	10,117 „
Uitvlucht	4,290 „
Klipplaatdrift	6,318 „
Leeuwkuil	12,012 „
Klipfontein	2,868 „
Total ...	42,135 Acres.

ON THE SOUTH BANK OF THE VAAL RIVER.

Name of Farm.	*Extent.*
Bankfontein	9,133 Acres.
Maccausvlei	9,096 „
Rietfontein	6,425 „
Driefontein	5,721 „
Total ...	32,375 Acres.

Along the river bank on the north side the Company's ground covers an extent of about 25 miles commencing at the eastern boundary of Zoekfontein and ending in the western boundary of the farm Klipfontein. This Company is the riparian owner of both sides of the Vaal River of the ground above stated, and claims that as a riparian owner it is entitled to use the water from the Vaal River for the purpose of irrigating its land.

It has been stated before the Commission that Messrs. Halse Bros. hold certain rights and servitudes on certain farms along the River Vaal, and the suggestion is that they have full rights to take from the Vaal River as much water as they may desire for the purpose of supplying Johannesburg and the mines. The Vaal River is a stream which is often in flood during the rainy season, and the flood time usually reaches its maximum about the month of February in each year. This month practically fixes the high water mark. During flood time the quantity of water in the river is naturally very great and amply sufficient for all purposes. From the high water mark in February, however, the stream gradually gets less in volume and usually during the months of May or June to December the quantity of water in the river is very small. Mr. George Kilgour who reported on the subject of a Vaal River irrigation scheme, stated that the quantity of water in the Vaal River during the winter or dry months at Engelbrecht's Drift was approximately 50 cubic feet per second, and Mr. Willcocks states further, that one cubic foot of water per second will irrigate 150 acres of land. On this basis of calculation there is barely enough water in the Vaal River in the dry season for the use of the riparian owners.

It is the intention of the Company at a later date, to go into the question of the construction of irrigation works on the Vaal River for the purpose of irrigating the land on the northern bank of the river. Here some 15,000 to 20,000 acres of land can be brought under irrigation.

It has been stated that part of Messrs. Halse Bros. scheme is to construct a dam across the Vaal River with the object of forming a lake many square miles in extent from which Johannesburg would be supplied. If this is done, then during the dry season from May or June to December practically no water will be left in the river below for the use of this Company or of the riparian owners lower down, and in this way very valuable private rights will be seriously injured.

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Appendix K.

Mr. J. N. de Jongh.

The Company denies that Messrs. Halse Bros. have the right to take the Vaal River water to Johannesburg to the injury of the rights of the riparian owners. I have caused an examination to be made into certain contracts held by Messrs. Halse Bros. over the farms Zoekfontein and Vischgat, and find that the rights given are limited to the taking of water out of the Vaal River by means of a furrow and the right to use a strip of land 12 feet wide. It is the contention of this Company that none of the contracts held by Messrs. Halse Bros. gave them any right to use the Vaal River water practically as a monopoly and to the exclusion of the rights of riparian owners whose lands are situated on the stream. The Vaal River water is at no time a safe potable water. During flood time the water has in suspension a very large percentage of vegetable matter, earthy matter and impurities and this percentage is high at any time.

This Company is the owner of two Coal Mines situated North and South of the Vaal River, from which Mines a large quantity of Coal for use on the Orange River Colony and Cape Government Railways is supplied. On account of the danger to the health of its employés and the outbreak of typhoid fever from time to time the use of the Vaal River water for drinking purposes has had to be discontinued, and other sources of water supply for drinking purposes by the Company's employés have been found. If the enormous reservoir is built according to Messrs. Halse Bros.' scheme there would be a serious danger to the Railway Bridge and works, and the Station and Township of Vereeniging and the Company's mines and works situated below it. Should the Reservoir burst at flood time, everything below it on the River banks would be swept away. This would mean the destruction of the Railway Bridge, Station, Township and mines and a serious danger to some 3,000 inhabitants who reside or work there.

[End of Appendix.]

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